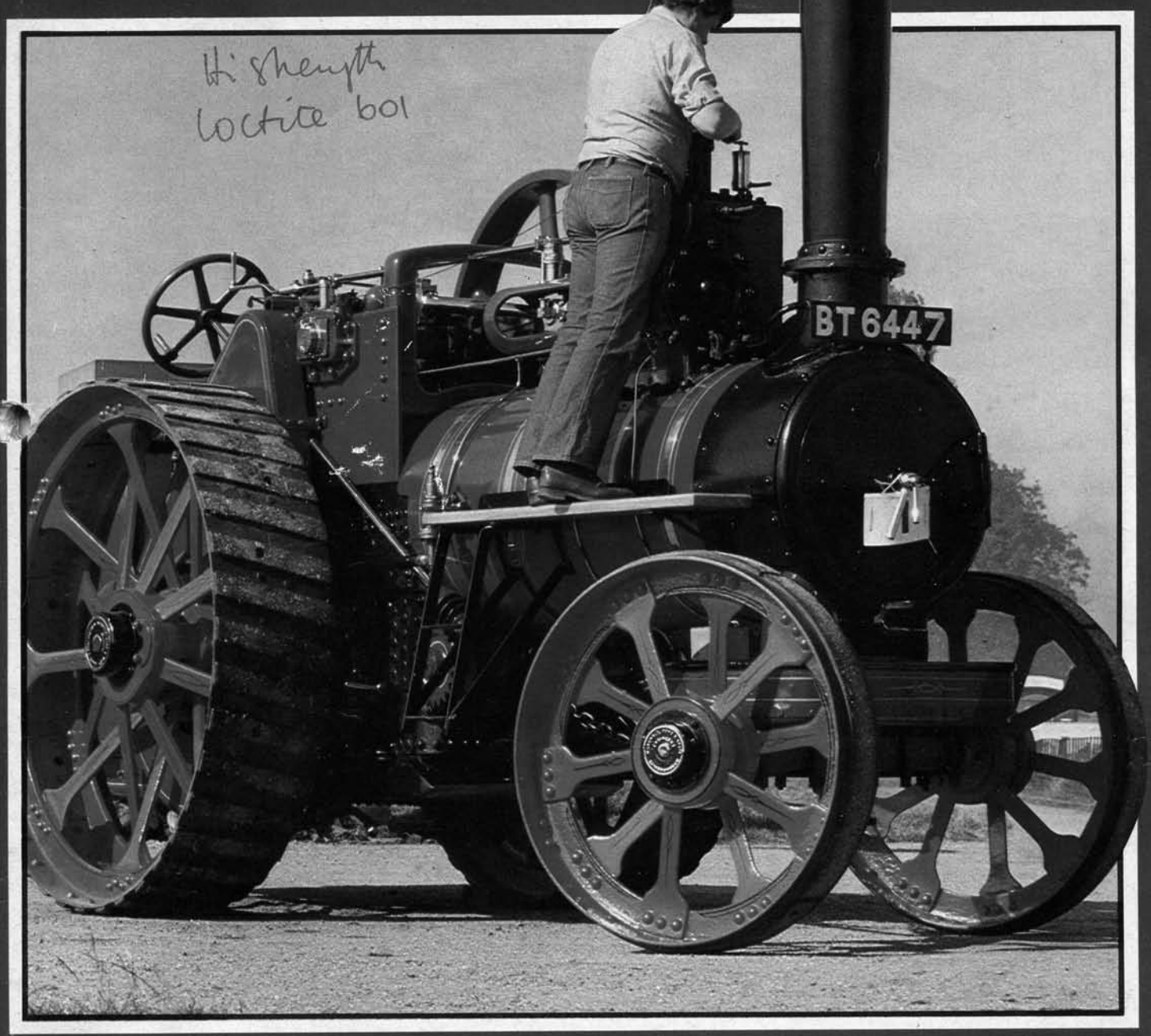
February 1979 45p
(U.S.A & Canada $2.00)

Model Mechanics

MAP HOBBY MAGAZINE



SIMPLE STEAM • TOOLS OF THE TRADE
TETHER RACING CAR • CASS RAILROAD

MODELLERS! SAVE £££'s

with PROOPS

Gears, pulleys, motors, power units, mechanical and electrical components

We're glad to welcome you to the first advertisement page of the first issue of **MODEL MECHANICS.** This new publication for the modeller might have been designed especially to suit typical Proops' customers, so closely does it promise to cover their interests. We're sure you will find the items featured here of interest, but to get a more comprehensive view of our range of products, visit our shop at ***52 TOTTENHAM COURT ROAD, LONDON, W.1*** (Open 9 am to 6 pm Monday to Saturday inclusive). This is truly a Mecca for Modellers, with a far-ranging and continually changing selection of useful and fascinating items for the hobbyist, experimenter and enthusiast. **Barclaycard and Access accepted. Any orders over £5 in value sent post free in U.K.** ***All Mail Orders to:*** **PROOPS BROS. LTD., Dept. MM, The Hyde Industrial Estate, Edgware Road, London NW9 6JS. Tel: 01-205 8006.** Our Mail Order service is fast and reliable, and we give special attention to the requirements of Schools, Colleges, Universities and Modelling Societies.

• AC/DC POWER UNIT

£1.50
carr. & pkg. 35p

Compact versatile unit in plastic case, suitable for a wide variety of modelling applications; power for small motor, miniature lighting circuits, etc. Input 220/240v A.C. 50 Hz. Output 12v 0.3a D.C.; 15v 0.5a A.C. Double insulated and fitted with Thermal Overload Cut-out. Size approx. 3 x 2 x 2 in. Approx. 8 ft. twin core mains lead.

• GEAR SET

£1.75 carr. & pkg. 25p

40dp white nylon matching gears, with two interlocking racks and 3v. motor with drive shaft to suit. Set comprises 5 gears (number of teeth shown in brackets), 40mm dia. (60); 33mm (50); 27mm (40); 20mm (30); 14mm (20); one pinion 7mm (10); two racks 103mm long (50); 3 x 115mm lengths shafting plus 3v. motor 35mm overall length x 24mm dia. with 7mm long drive shaft. All dimensions approx.

• FRESNEL LENSES

two for £1.70 carr. & pkg. 30p

Supplied as two separate lenses or mounted together as condenser assembly — state preference. Slightly imperfect but entirely suitable for IMAGE BRIGHTENERS, MAGNIFIERS, INTENSIFIERS. Precision worked in optical plastic, these flat lenses, 11in. square x 3mm thick provide an amazingly large area of magnification.

• 184 PIECE ALPHABET KIT

£1 carr. & pkg. 30p

Play word games and have fun with one of these kits. It's fun for the youngsters to learn to spell this way. And fun for adults teaching or playing. Kits comprise 144 gaily coloured plastic capital letters 1½in. high and 40 numerals 1in. high, plus signs. Also ideal for clubs, pubs, shops, for indoor or outdoor signs and displays with letters cemented to board.

• AUDIBLE WARNING DEVICE two for £1 p.&p. 15p

A well-made solid state unit which produces a piercing modulated tone ideally suited to system failure warning, paging, etc. 6/12v. D.C. Size approx. 1¼in. diam. x ½in. deep.

• MOIRE PATTERNS in colours!

Proops Moire Pattern Kit No. 1 contains full-size reproductions of eight basic patterns reproduced in black, red, yellow and blue on thick clear acetate sheeting and in black on heavy opaque coated white card. Also included is a grid reproduced in black.

PRICE £3.50 Carr. & pkg. 30p

Also available — Proops Moire Pattern Kit No. 2, containing single radial pattern set 8¾in. dia. in primary colours and black.

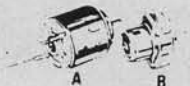
Carr. & pkg. 30p **£1.95**

• CHANGE OVER REED SWITCH

With 12v. operating coil and 2 additional Reed Switches **£1** p&p 20p

• MODEL MOTORS 1½ — 4½ v

10 for £1.50 carr. & pkg. 25p



Fantastic bargain! Pack of TEN 1½ — 4½v. D.C. motors, consisting of 4 Type A, 3 Type B and 3 Type C (not illustrated but similar to type A, with pinion on drive shaft). Compact, hard-working and versatile units to provide motive power in a host of modelling applications.

• MODEL MOTOR 12v. Johnson Type 333.

Approx. 1¼in. long x 1in. diam. Spindle ½in. long x 1/16in. diam. **75p** carr. & pkg. 15p

• PULLEY SET

£1.75 carr. & pkg. 25p

All modeller needs to make up fascinating step-up, step-down, reverse motion pulley mechanisms. Set of 8 white nylon pulley wheels, consisting of two 30mm dia. two 20mm dia. and four 11mm dia., i.e. in a ratio of approx. 1:2:3. 16 interchangeable bosses also supplied for making up fixed or loose, single or double, pulleys, together with suitable shafting and driving bands. PLUS a 3v. D.C. motor complete with mounting brackets and screws to power your model. Full instructions and illustrated examples included.

• MAKE SCENERY, TRACKSIDE BUILDINGS 99p

carr. & pkg. 25p

WITH THIS AMAZING **POLYSTYRENE FOAM CUTTER**

Clean, easy and fun to use! Carves expanded polystyrene tiles, sheets or blocks up to 2in. thick like a knife through butter! No pressure needed, no hard work! Just connect to 4½v. battery and push button. Cut out and shape buildings, scenery for the railway modeller, wall decorations, toys, plaques, etc. Complete with 3 spare wires and full instructions.

• ELECTRIC CLOCK TIMER

£1.75 Carr. & pkg. 55p

Mains operated electric clock powered by 3w. synchronous motor and engineered to the highest standards of reliability. Makes a useful timepiece but originally intended as a cooker time switch. Can be used in dozens of control situations, such as converting radios to clock radios, switching on lighting, process timing, etc. Switches up to 25A 230/240v. AC 50 Hz and can be pre-set to allow once on / once off switching in a 5-hour period.

• BEARINGS, precision made, three types.

Type 11, 5/8in. o.d. x ¼in. i.d. fully shrouded; Type 16, ¾in. o.d. x 3/16in. i.d. self-centering; Type 4, 5/8in. o.d. x 3/8in. i.d. x 7/8in. long, needle bearing. Pack of any four bearings (state requirements) **£1** p.&p. 15p

SEE OUR RANGE ON . . .

STAND No. 15

48th Model Engineer Exhibition

Jan. 4-13 1979 — **Wembley Conference Centre**

PROOPS BARGAIN PACKS

£1 EA. plus p+p

Useful selections of a wide range of materials, components, etc., in convenient packs. Please note you must send £1 for each pack you order, plus the p.& p. indicated against each item. Any five packs sent post free U.K.

SELF TAPPING SCREWS: A generous 1 lb. mixture of about 500 screws in useful sizes and lengths from ¼ in., various heads. p&p 50p.

STEEL WASHERS. About 500 in a useful 20 oz. pack that every tool box needs. p&p 50p.

SHAKEPROOF AND STAR WASHERS. About 500 in a good, varied selection of sizes, weighing 6 oz. p&p 20p.

HOSECLIPS. Pack of 25 in assorted sizes from 7/8 in. p&p 25p.

SPACERS. Pack of approx. 100, good selection of useful sizes, various lengths and diams. p&p 25p.

CROC CLIPS. Pack of 16 1½ in. long. p&p 15p.

SPADE AND RING CONNECTORS. As used in cars and domestic appliances. Pack of approx. 100 connectors. Balanced selection, insulated and plain. p&p 25p.

SPRINGS. Generous and varied selection, compression and expansion springs, lengths from approx. ½ in. to 2⅛ in. and diameters from 3/16 in. to 1½ in. Pack of approx. 100. p&p 25p.

PLASTIC TERMINAL BLOCKS. 5A, 2-way. Pack of 20 p&p 20p.

BOWDEN CABLE. Miniaturised cable ideal for modellers, control gear, etc. Sheath approx. 1mm o/d 2 x 3 ft. (approx.) lengths. p&p 20p.

CASTORS. 1 in. diam., 2 hole fixing. Pack of 8. p&p 35p.

COPPER TUBING. Approx. 4⅛ in. lengths formed into elbows approx. 6mm o/d x 4mm i/d. Pack of 20. p&p 25p.

TRANSFORMER. Double wound 240v. input, 12v. 200 mA output. Size approx. 1⅛ in. x 1¼ in. x 1⅛ in. Pack of 2. p&p 55p.

PRESSURE GAUGE. 0-60 psi, calibrated 0-4 atmospheres. Approx. 1⅛ in. diam. with ⅛ in. BSP connection back entry. Pack of 2. p&p 15p.

POLARISING FILM. Approx. 6 in. x 3 in. x .03 in. thick full wave, linear polarising. p&p 15p.

LIGHT GUIDES. Yes, you can 'Bend' light round corners with these high quality glass fibre optics. 1mm active area 2 metres. p&p 15p. OR 2mm, active area 1 metre. p&p 15p.

SPIRE NUTS AND CLIPS. Generous selection, approx. 12 oz. assorted sizes. p&p 35p.

MICROSWITCHES. Good selection six types, make, break and changeover. p&p 25p.

MAINS NEONS in plastic holders with leads and resistors. Pack of 5. p&p 15p.

MAINS NEONS, miniature type, pack of 10. p&p 15p.

MAINS NEONS, pack of 20, with plastic "panel jewels". p&p 15p.

MIXED SLEEVING. Good selection of various cut lengths and sizes, inc. 2 x 25 yd. lengths Vidaflex, 1.5mm bore. p&p 30p.

MULTICORE CABLE. Approx. 5mm o.d. each core contains 7 strands. 15 metre pack of 4-core, or 12 metre pack of 6-core, or 10 metre pack of 8-core. Each pack £1 plus 25p. p&p. State requirements.

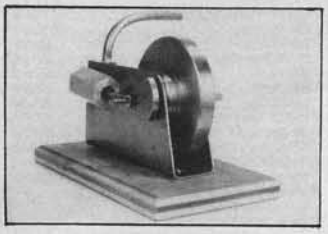
SAVE MORE!

ORDER FIVE PACKS AND WE'LL SEND THEM POST FREE U.K.!

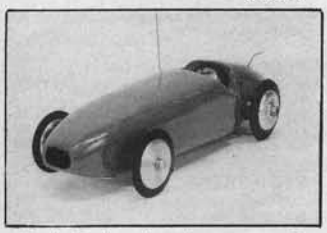
Model Mechanics

VOLUME 1 Number 1 FEBRUARY 1979

Cover picture: A fine subject for a working model. 1923 7hp Marshall Agricultural Traction Engine, owned by Mr P. C. Bath, of Roxton, Bedfordshire. *Photo by Alan Neale Picture Agency.*



Oscilating engine for the beginner—page 10.



'Tyro'—Beginner's racing car—page 32.

CONTENTS

Editor's Chat 9

Making a Start in Steam — John Wheeler discusses the construction of an oscillating engine 10

Tools of the Trade — Jim King tests the Cowell '90' lathe 16

Electronics — A simple power supply unit described by George Wainwright 20

Jim King's Travels — The Cass Railroad 24

Q and A — Your questions answered 27

Introduction to model railways — Cyril Freezer, editor of 'Model Railways', explains the gaugues 28

Tyro — A beginner's tether racing car by Geoff Sheppard 32

Engineering from scratch — A basic course by Alan Carter. In this issue, reading drawings 41

'Daisy' — Steam power motor boat without a steam engine by Basil Harley

Radio controlled motor car racing — by 'Dickie' Laidlaw-Dickson 50

The Development of the railway steam locomotive — Martin Evans leads up to a locomotive constructional article 54

MM Club Report 59

This periodical is sold subject to the following conditions: that it shall not, without the written consent of the publishers be lent, resold, hired-out or otherwise disposed of by way of Trade at a price in excess of the recommended maximum price and that it shall not be lent, re-sold, hired-out or otherwise disposed of in a mutilated condition, or in any unauthorised cover by way of Trade; or affixed to or as part of any publication of advertising, literary or pictorial matter whatsoever.

Second-class postage rates paid at New York, U.S.A. Registered at the Post Office for transmission by Canadian Post. American enquiries regarding news stand sales and advertising should be sent to MODEL MECHANICS, Eastern News Distributors Inc., 111 Eighth Avenue, New York, N.Y. 10011, U.S.A.

Enquiries regarding Hobby Shop Sales to Bill Dean Books Ltd., 166-41, Powell's Cove Boulevard, Whitestone, New York 11357, U.S.A. Telephone: (212) 767-6632.

Model & Allied Publications Ltd

Editorial and Advertisement Offices: **P.O. Box 35, Hemel Hempstead, Herts, HP1 1EE**
Tel: Hemel Hempstead — Editorial/Advertising 41221

The Editor is pleased to consider contributions for publication in "Model Mechanics". Manuscripts should be accompanied if possible by illustrations and should also have a stamped addressed envelope for their return if unsuitable. While every care is taken, no responsibility can be accepted for unsolicited manuscripts, photographs, art work, etc.

Subscription department:
Remittances to **Model & Allied Publications Ltd.,** P.O. Box 35, Hemel Hempstead, Herts. HP1 1EE (Subscription Queries Tel: 0442 51740).
Subscription Rate: £7.50 ($15.00).

MAP

Also published by MAP: Model Engineer; Aeromodeller; Model Boats; Radio Control Models & Electronics; Model Railways; Scale Models; Military Modelling; Woodworker; Gem Craft; Clocks.

Model Mechanics is printed in Great Britain by New Avenue Press, Feltham, Middx., for the proprietors and publishers, Model & Allied Publications Ltd. (a member of the Argus Press Group), 13/35 Bridge Street, Hemel Hempstead, Herts. Trade sales by Argus Distribution Ltd., 12/18 Paul Street, London, E.C.2, to whom all trade enquiries should be addressed.

M.M. QUERY COUPON FEBRUARY 1979

RAILMAIL OF WATFORD

Save Pounds on our 100 Santa Specials - Beat the rush!

HORNBY LOCOS

R041 Pannier Tank	£6.95
R052 Jinty Tank	£7.30
R058 BR Tank	£7.10
R063 Britannia	£13.25
R065 Evening Star	£14.20
R066 Duchess	£13.80
R077 GWR Tank	£4.95
R078 King Edward	£12.95
R150 B12	£8.30
R252 J83	£6.49
R761 Kneller	£9.95
R842 Class 5 Red	£12.95
R845 Scotsman Loco	£11.95
R852 Ivatt	£10.70
R154 Sir Dinadan	£10.70
R068 Class 25 Blue	£7.90
R072 Class 25 Green	£7.90
R074 Hymeck	£7.90
R075 Brush 47	£11.49
R080 Class 295 Green	£7.70
R084 Class 29 Blue	£7.70
R156 Diesel Shunter	£5.70
R751 Coco Diesel	£8.40

New 1979
Hornby Catalogue ..... 50p post paid

HORNBY PRICES ARE NOW INCREASED BY 10%. WE SHALL HOLD THESE PRICES UNTIL 31.1.79 AT 1978 LEVELS. PLUS FREE WAGON WITH EVERY LOCOMOTIVE SOLD.

COACHES

R213 GWR Coach	£1.15
R229 Pullman Coach	£2.99
R230 Golden Arrow	£2.99
R429 GWR Coach	£2.40
R430 GWR Brake	£2.40
R431 SR Coach	£2.40
R432 SR Brake	£2.40
R433 LMS Coach	£2.40
R434 LMS Brake	£2.40
R435 LNER Coach	£2.40
R436 LNER Brake	£2.40
R437 BR Coach	£2.40
R438 BR Brake	£2.40
R439 BR I/City Ch.	£2.40
R454 GWR Rest. Car	£2.40
R448 LNER Sleeper	£2.40
R449 Lighting Unit	£1.15
R413 LMS Royal Mail	£4.40

BUILDINGS

R190 Cottage	£1.25
R191 Coaling Stage	£1.65
R192 Goods Shed	£1.70
R193 Village Shop	£1.70
R194 Petrol Stn.	£1.90
R196 Bungalow	£1.30
R199 Station	£3.88
R503 Signal Box	£1.60
R504 Loco Shed	£1.95
R505 Water Tower	£1.85
R506 Goods Shed	£1.90
R510 Plat. Shelter	£1.10
R511 Waiting Room	£1.99
R512 Booking Hall	£2.99
R513 Fencing	90p
R590 Station Halt	£2.45
R591 Branch Station	£3.45
R592 Mainline Station	£4.45
R593 Town Station	£6.99

TRACK

R410/11 Turntable	£8.75
R476 Convertor	60p
R600 Straight	22p
R601 Straight	36p
R602 Power Clip	36p
R604 Curve	25p
R605 Curve 1st	33p
R606 Curve 2nd	27p
R607 Curve Double	36p
R608 Curve	27p
R609 Double Curve	36p
R612 LH Point	£1.40
R613 RH Point	£1.40
R614 LH Diamond	£1.30
R615 RH Diamond	£1.30
R617 Uncouplers	25p
R624 Underlay LH	45p
R625 Underlay RH	45p
R64 LH Point	£1.95
R641 RH Point	£1.95
R643 ½ Curve	20p
R361 No. 1 Track Pack	£2.90
R362 No. 2 Track Pack	£3.95
R363 No. 3 Track Pack	£3.99
R400 Signal Control	£3.99
R405 Signal Colour	£2.75

CHECK THESE PRICES SEE WHAT YOU SAVE, BY BUYING THE RAILMAIL WAY. ALL PRICES WILL INCREASE ON 31ST JANUARY, 1979 — SAVE POUNDS BY BUYING NOW.

PECO OO TRACK WORK

25 yds N/S	£16.99
25 yds Steel	£11.99
91X SY Points LH	£1.55
92X SY Points RH	£1.55
95X Med. Points RH	£1.95
96X Med. Points LH	£1.95
97X Small Y	£1.75
98X Large Y	£2.10
Point Motor	90p
88X RH Large	£2.15
89X LH Large	£2.15
86X RH Curved	£2.25
87X LH Curved	£2.25
93X Short Cross	£1.45
94X Long Cross	£1.75

LIMA OO

J50 BR Black	£4.65
J50 LNER Green	£4.65
Type 33 Blue	£5.75
Type 33 Green	£5.76
Deltic Diesel Blue	£6.00
Deltic Diesel Green	£6.00
GWR King	£10.99
BR King	£9.99
BR Prairie	£6.60
GWR Prairie	£6.60
LMS Diesel Shunter	£4.99
BR Diesel Shunter Green	£4.99
BR Diesel Shunter Blue	£4.99

H & M POWER UNITS

Last call at these low, low prices!

H&M Duette	£14.99
Clipper	£10.99
DC Multi Pack	£7.00

AIRFIX OO

GWR Prairie	£8.99
BR Prairie	£8.49
LMS Fowler	£9.99
BR Fowler	£9.99
A.1.A Diesel Blue	£7.75
A.1.A Diesel Green	£7.75
14XX Tank GWR	Check
14XX Tank BR	delivery
BR Royal Scot	and
LMS Royal Scot	price
LMS Corr. Coach	£2.69
LMS Corr. Brake	£2.69
BR Comp. Coach	£2.69
BR Comp. Brake	£2.69
Intercity Coach	£2.69
Intercity Brake	£2.69
GWR B Coach	£2.69

MAINLINE OO

J72 Black	£6.99
J72 Green	£7.70
Royal Scott BR	£16.99
Royal Scot LMS	£16.99
Class 45 Diesel Blue	£10.49
Class 45 Diesel Green	£10.49
Class 4 Black	£13.78
Class 4 Green	£13.78
Red/Cream Coach	£2.70
Red/Cream Brake	£2.70
Choc/Cream Coach	£2.70
Choc/Cream Brake	£2.70
Maroon Coach	£2.70
Maroon Brake	£2.70
Blue/Grey Coach	£2.70
Blue/Grey Brake	£2.70
6 assorted Wagons our choice	£5.00
6 assorted Tank Wagons our choice	£6.00

NEW RELEASE AIRFIX
BOOKING HALL, SIGNAL GANTRY, TRACKSIDE ACCS., PLATFORM ACCS., WATER TOWER

GRAFAR N

BR Black 5	£14.00
LMS Black 5	£14.00
GWR Hall	£12.50
BR Hall	£12.50
SR Spitfire	£12.50
BR Spitfire	£12.50
GWR Prairie	£10.50
BR Prairie	£10.50
BR Pannier	£8.25
GWR Pannier	£8.25
SR Tank	£8.00
BR Tank	£8.00
LMS Tank	£8.00
LNER Tank	£8.00
10 Assorted Wagons & Vans	£7.50
Suburban Coach	£1.65 ea.
Suburban Brake or Mainline Coach	4 for £6.00
Mainline Brake Available in LMS, SR, LNER, GWR, BR Liveries	
Pullman Coach	£1.99
Pullman Brake	£1.99
4 Wheeled Coach	£1.10 ea.
4 Wheeled Brake	£1.10 ea.

or any 4 for £3.99 available in LMS, SR & LNER Liveries.

PECO N

25 yds N/S Wood Sleeper	£13.50
Points	
RH or LH Med.	£1.70
RH or LH Large.	£1.90
RH or LH Curved	£1.95

STOP PRESS

1979 Hornby Catalogue ..... (post free)	50p
5th Edition Track Plans ..... (post free)	55p

LATEST RELEASES!

NEW FROM AMERICA — WOODLAND SCENICS, THE QUALITY SCENIC

Tree Kits		Turf		Foliage	
Str. Trunk	£1.80	Soil	85p	L. Green	85p
Softwood Pine	£1.80	Yellow Grass	85p	M. Green	85p
Double Fork	£1.80	Earth	85p	Dark Green	85p
Shade Tree	£1.80	Burnt Grass	85p	Conifer Green	85p
Columnar Pine	£1.80	Green Grass	85p	Early Autumn	85p
Gnarled Tree	£1.80	Weeds	85p	Late Autumn	85p
Pine Trees	£3.60	Green Blend	£1.70	Ballast D. Brown	
Big Old Trees	£3.60	Earth Blend	£1.70	Brown, Buff	85p
		Coal Mine	85p	Lt. Grey, Grey, Cinders.	85p ea.
		Coal Lumps	85p		

Visit our Stand at Model Engineer Exhibition, Wembley

TERMS OF BUSINESS: All items are in stock or on order 26.11.78 and should be in stock on date of publication.

ACCESS & BARCLAYCARD HOLDERS: Telephone our sales staff on Watford 46966 — 3 lines (Std Code 0923) or 041-221-3111 for instant despatch against available stock. All orders Post Free but we cannot accept orders under £5.00 with the exception of catalogues. **Please make cheques/postal orders payable to Railmail (Model Rlwys) Ltd.**

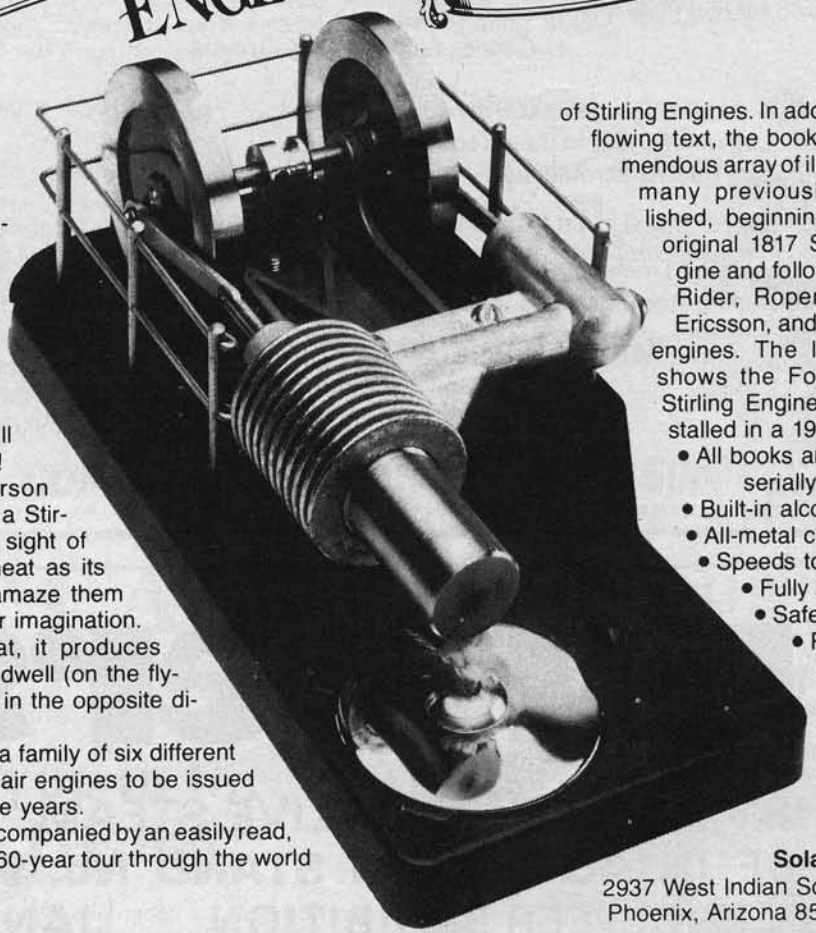
RAILMAIL OF WATFORD
65 VICARAGE ROAD, WATFORD, HERTS.
0923-46966 (3 lines)
Open 9.00 - 5.30 Monday-Saturday. Closed Christmas Day & 1st January. Open Boxing Day 10.00-3.00.

DIAL-A-TRAIN— If you have Access/Barclaycard place your order on our answering machine outside business hours 0923-46966.

RAILMAIL OF SCOTLAND
121 WEST REGENT STREET, GLASGOW, C.1.
041-221-3111.
Open January Monday-Friday 10.00-3.00 Saturdays 9.00-5.30

BRITAINS No1 SUPPLIER OF MODEL RAILWAYS

STIRLING ENGINE 1817-1977 CYCLE



Heat is the only fuel this fascinating engine requires. The heat may be from any source: burning newspapers, charcoal, alcohol or, when attached to a readily available parabolic mirror, it will run on solar energy!

The average person has never heard of a Stirling Engine, so the sight of one running, with heat as its only fuel, will first amaze them and then excite their imagination. Furnished with heat, it produces power. Change the dwell (on the flywheels) and it runs in the opposite direction.

This is the *first* in a family of six different desk-top model hot air engines to be issued during the next three years.

Each engine is accompanied by an easily read, 128-page book. A 160-year tour through the world of Stirling Engines. In addition to the flowing text, the book has a tremendous array of illustrations, many previously unpublished, beginning with the original 1817 Stirling Engine and followed by the Rider, Roper, Heinrici, Ericsson, and other heat engines. The last photo shows the Ford-Phillips Stirling Engine neatly installed in a 1975 Torino!

- All books and engines serially numbered
- Built-in alcohol burner
- All-metal construction
- Speeds to 1000 rpm
- Fully assembled
- Safe and silent
- Fully tested
- 7½" x 4"

Solar Engines
2937 West Indian School Road
Phoenix, Arizona 85017 U.S.A.

Hobbyist's Power Source • For The Executive Desk • Experimenters & Collectors

Solar Engines
2937 West Indian School Road
Phoenix, Arizona 85017 U.S.A.

☐ Check ☐ Money Order

Charge my: ☐ Master Charge

☐ American Express

☐ BankAmericard ☐ VISA

INTERBANK NO.

CARD NO.

EXPIRATION DATE

Please send me:

☐ Engine and Book ____ @ $31.00

☐ Book (separately) ____ @ $ 4.00

(Domestic shipments are sent postpaid. Overseas orders for Engine and Book require an additional $8.00 postage (airmail) and $1.50 additional postage for Book only.)

$_____

$_____

TOTAL $_____

SIGNATURE

NAME (PLEASE PRINT)

ADDRESS

CITY STATE ZIP

ME3

MEASURING EQUIPMENT
by CARL ZEISS SUHL

Sample prices inclusive of VAT 8%, postage and packing for Plain Anvil Micrometers:

0—1″	£8.50	3—4″	£15.90
1—2″	£12.15	4—5″	£17.55
2—3″	£13.90	5—6″	£19.10

Available up to 12″, also in metric equivalents

Complete boxed set of 4 Plain Micrometers 0—4″ ... £56.40
Complete boxed set of 6 Plain Micrometers 0—6″ ... £92.15
Carbide faced £3.15 each extra

3515 2″ dia. Dial Gauge .00005 div.,
Back Lug mount, also in metric equivalent ... £9.50
Carl Zeiss Depth Micrometers 0—4″ ... £20.10
0—6″ ... £24.90

Dial Gauges, Verniers and many other items — please send S.A.E. (9″ x 4″) for full price list on Carl Zeiss Suhl and other leading manufacturers' equipment, also unrepeatable clearance offers — addressed to:

MERCER PNEUMATIC TOOLS LIMITED
Springfield Works
Cleckheaton BD19 6JT
West Yorkshire
Tel: Cleckheaton 874586

puffers

HORNBY HOBBIES REAL LIVE STEAM "ROCKET" WILL BE IN ACTION ON **STAND No. 90** AT THE MODEL ENGINEER EXHIBITION JAN. 4-13, 1979

Hornby '00' Model Railway accessories and other leading model railway accessories will be on sale at **puffers** super discount prices.

We are showing a complete Hornby model railway layout, available as a complete kit for £103.62, or as individual items. Why not turn that train set into a proper model railway? A full working layout will be on show on **Stand 90** and the complete range of Hornby, Mainline, Airfix, Lima, Peco, etc., etc.

THE PUFFERS BUS WHY NOT VISIT OUR MODEL RAILWAY SHOWROOM, RAILWAY BOOKSHOP AND 'BIG D'S' FINESCALE DEN, ONLY 2 MILES AWAY FROM THE WEMBLEY CONFERENCE CENTRE? The **puffers** bus will be offering a FREE RIDE between Kenton and Wembley at 20 minute intervals throughout the period of the Exhibition.

Remember, our Model Railway Showroom is packed with super discount British '00' and 'N' model railways plus 'Big Dave's 'Fine Scale Den' for the model loco kit-builder and fine-scale enthusiast.

puffers Railway Bookshop offer over 100 different railway titles and piles of second-hand magazines including back numbers of the 'Model Engineer'.

For the 1 Gauge steam enthusiast we are expecting a new delivery of Aster Live Steam Locos including 4-4-0 Schools 231 K French Pacific and the USA Shay.

puffers LONDON'S LEADING MODEL RAILWAY RETAILERS

134A KENTON ROAD, KENTON, MIDDLESEX (01) 907 8271

A. J. REEVES & CO (Birmingham) LTD

Incorporating DICK SIMMONDS & COMPANY

HOLLY LANE, MARSTON GREEN, BIRMINGHAM, B37 7AW **Tel: 021 779 6831-2-3**

DID YOU KNOW THAT WE CARRY 30 TONS OF CASTINGS IN GUNMETAL, IRON, ALUMINIUM AND NICKEL SILVER FOR THE FOLLOWING LOCOMOTIVE, STATIONARY AND TRACTION ENGINES!

In 3½" Gauge:
Tich (2 versions), Juliet (2 versions), Netta, Vera, Britannia, Rob Roy, Mabel, Canterbury Lamb, Titfield Thunderbolt, Doris, Princess Marina, Rodean, Jubilee, Firefly, Lickham Hall, 1000 Class, Country Carlow, Virginia, B.R. Standard Cl 5, Caribou, Buffalo, Jeanie Deans, Molly, Hielan Lassie, Masie, Bantam Cock, Mona, Alco Mountaineer, Derby Class 4 and Greene King.

In 5" Gauge:
Netta, Rail Motor, Metro, Fury, Princess of Wales, Jersey Lily, Immingham, Robinsons 2-8-0, Maid of Kent, Springbok, Pansy, Speedy, Simplex, Nigel Gresley, Boxhill, Stirling Single, Reeves 0-6-0. G.W.R. 51xx Cl, Torquay Manor, Fury, Royal Engineer, Asia, Ajax, Achilles and Kings Own.

In 7¼" Gauge:
Highlander, Bridget, G.W.R. King George V, Holmside, Hercules and Jessie.

Traction Engines:
1" Sc "Mini" T.E., 1½" Sc "Allchin", and the 2" Sc Burrell "Thetford Town". Marshall 1½" Portable.

Stationary Engines:
M.E. Beam Engine, Heinrici Hot Air Engine, Vulcan Beam Engine, "Mary" Beam Engine. Perseus, Warrior, Trojan, Unicorn, Reeves Monarch, Master Range of Oscillating Engines, Horizontal, Vertical and Hor Opposed, and Popular Vertical, Double Tangye, Diagonal Paddle Engine, and the Centaur Gas/Petrol Engine.

Plus:
Many sets of castings for workshop equipment, backed up by the largest selection of materials in Copper, Stainless Steel, Cast Iron, Monel Metal, Brass, Phosphor Bronze, Nuts, Screws, Bolts and Rivets specially stocked for the Model Engineer in the World.

THE STORE FOR MODEL ENGINEERS, STAFFED BY MODEL ENGINEERS.

COMPREHENSIVE CATALOGUE 50p

Send for your copy NOW! 50p post free. Overseas post extra. Airmail if requested.

R/C CARS

JUST PHONE YOUR NUMBER

Ted Longshaw for Service & Experience

Let Ted put you in the picture too : HE did!

We hold the largest selection of radio control model car kits, accessories and special items in the U.K. Normally MAIL ORDER ONLY we have just printed a NEW EXTRA-SPECIAL CATALOGUE with loads of pictures covering a vast range of products all in the R/C car range. Size 8¼ x 5¾ ins. it has 60 pages with something of interest on every one. Send 50p for it right away (or on sale at Model Engineer Exhibition on Ted's Stand), read it and order up (your 50p is credited against your first order.

We carry the following Marques Kits and Spares: Associated, Delta, Marker, Thorp, PB International, SG, Serphant, plus 1/12 ELECTRICS Associated Bo-Link, Lectricar, Mardave, MRP, LEXAN & ABS Bodies in 1/8 & 1/12. **Radios** (two channel only) — Futaba Twin-Stick, Futaba Steering Wheel, Digiace, Sanwa, MacGregor, Trigger Conversion Kit. Accessories include AMPS differential, PB Diff., Serpent Disc brakes, Perry Pumper Carbs. **Tyres** 1/8 & 1/12 from all major manufacturers — Associated, UFRA, Thorp, Delta, PB, etc. **Engines** — OPS, STX21, K & B, VECO. You name it — we have it!

MAIL ORDER ONLY (No stock held at Pepys Road). We also have a SHOWROOM near Biggin Hill that can be visited by appointment only (Tel: 0689 [London 66] 55313).

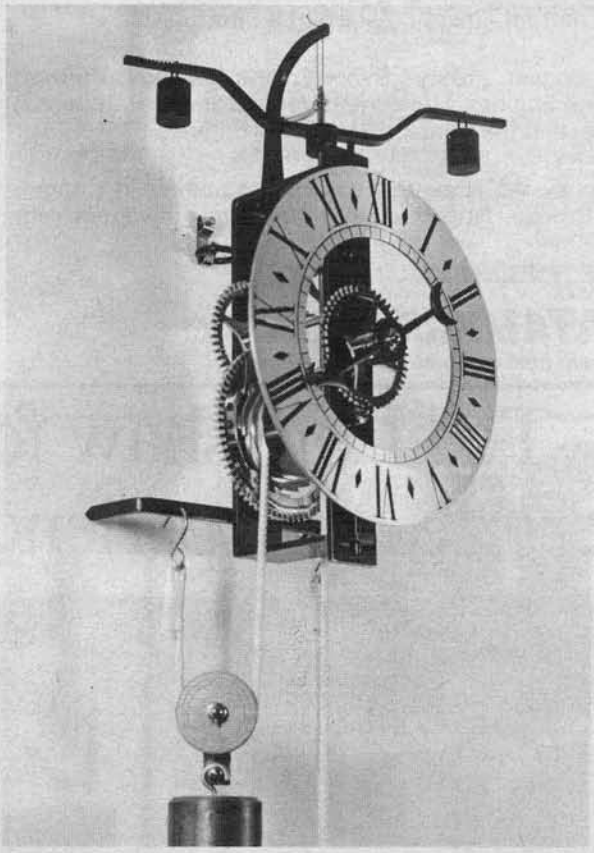
Mail Order Only Address: European Export No Problem *Trade Enquiries Welcome*

80 PEPYS ROAD, LONDON SE14 01-639-5080

CLOCKMAKING

For perhaps the first time, a really simple but nonetheless absorbing clockmaking project is available.

In "**Clockmaking with the Unimat 3**" world famous author John Wilding sets out to describe the construction of an early and simple clock mechanism using an inexpensive lathe with standard accessories for wheelcutting.



The serial does not assume that the reader is aware of the basic methods and techniques used in horology or lathework. For instance, it is not assumed that a beginner will know of a broach and how to use it; nor does the author dismiss with a cursory instruction how to cross out a wheel.

The value of illustrations in learning new techniques is clearly understood: the serial has 200 photographs and 26 drawings. Full details are given for the supply of all the materials and tools required.

The serialisation of this project starts with the December issue of the Horological Journal, the Watch and Clock Journal, and runs 12 months.

Why not take out a subscription now?

SPECIAL Winter Edition
HOROLOGICAL JOURNAL 85p
WATCHES & CLOCKS

Subscription Rates Post Free
Including a fee for the full period of the subscription to the Watch & Clock Book Society. Non Returnable.

1 Year (12 issues)	UK	£ 8.45	☐
	Overseas	£ 9.95	☐
	USA (Special Air Service)	$22.25	☐
3 Years (36 issues)	UK	£21.50	☐
	Overseas	£25.00	☐
	USA (Special Air Service)	$55.75	☐

Please mail the above to me:

I enclose my check, cheque or money order payable to Brant Wright Associates Ltd for
or charge my Access, American Express, Eurocard, Mastercharge

Account No. _____
Signed _____
Name _____
Address _____
_____
_____

Brant Wright Associates Ltd
PO Box 22 22A Bank Street Ashford Kent England or PO Box 1305 Long Island City NY 11101 USA
The World's Leading Horological Publishers Publishers of the Horological Journal

Editor's Chat

Welcome to *Model Mechanics*, the new magazine published for those who would like to become model engineers but lack the knowledge, skills, or workshop equipment necessary. No engineer was ever born with an inherent knowledge of engineering although some certainly take to the subject with a greater natural aptitude than others. There are a few, fortunate people who have a workshop readily available but until they have been taught to use it they are no better off than those with only basic equipment.

Whether you have already learned the elementary skills of engineering or are just beginning, whether your workshop consists of a few hand tools or the latest thing in machinery, *Model Mechanics* is designed to give you the necessary assistance to enable you to join one of the most rewarding of all constructional leisure activities — that of model engineering. You may already know of the magazine *Model Engineer.* Now published for over 80 years, this magazine has a well-established record, and is read in every country where model engineering is practised. It offers constructional and instructional articles on a wide variety of models and techniques written by the world's foremost exponents in the art. Why then have the publishers of *Model Engineer* decided to launch this new magazine? Very simply because our experience has shown that a need exists for such a publication. Many letters to *Model Engineer* have requested the type of article which to the more experienced readers would have, regretfully, been seen as a waste of space.

ORIGIN IN HISTORY

To some readers the title may have a vaguely familiar ring. In 1946, against the problems of a paper shortage, *The Model Mechanic* was launched by The Drysdale Press. A few months later the car section had grown to such proportions that it was decided to introduce *Model Cars* as a separate publication. Late in 1950 the two magazines reunited under the title of *Model Maker* which eventually joined Model & Allied Publications and ultimately became *Model Boats.*

Thus the titles *The Model Mechanic, Model Cars* and *Model Maker* were lost to the enthusiast and were not completely compensated for by the other magazines. The time is now ripe for the situation to be rectified. Although model tether car racing has lost its fantastic following of earlier years there are sufficient numbers of enthusiasts — both experienced and otherwise — to justify inclusion in *Model Mechanics.* Hopefully the seeds of this fascinating sport may be sown in the new readership and the successes of the 1950s may be repeated.

Although in full size practice the use of steam power is now almost confined to turbines, its charm has endeared it to young and old alike. *Model Engineer* owes much of its popularity to the steam engine — mostly in locomotives. *Model Mechanics* will not deviate from this trend but nor will it ignore all other forms of power. In short, whatever your interests are in the model making world, we would like to think that *Model Mechanics* will go a long way to meet them. Most of the work involved will be in metal because we feel that other materials are adequately covered by other magazines, but where a project requires the use of non-metallic materials we will not hestiate to incorporate them.

Nor will electronics be excluded. In this age of computers the use of electronics cannot be overlooked. Many models, even those powered by steam, are now radio controlled — cars using this method of operation have reached a high degree of popularity and we are fortunate in having 'Dickie' Laidlaw-Dickson, managing editor of *Radio-Controlled Model Cars* writing for us.

It was, in fact, Mr Laidlaw-Dickson who founded *The Model Mechanic* over 30 years ago and we are extremely pleased that he is associated with the re-birth.

SKILL BY STAGES

Step-by-step, *Model Mechanics* contributors — among them craft teachers from some of the country's most modern schools — will assist the reader in understanding the basic principles of steam power, internal combustion and hot air engines, workshop practice, including soldering, welding and blacksmithing, electronics and the construction of many models from a simple stationary oscillating engine to a 2½ inch gauge steam locomotive, from a simple racing car to a highly powered competition model.

Those who prefer the layouts of smaller railways will have regular articles by Cyril Freezer, editor of *Model Railways.* If we have missed anything we would welcome your letters and suggestions.

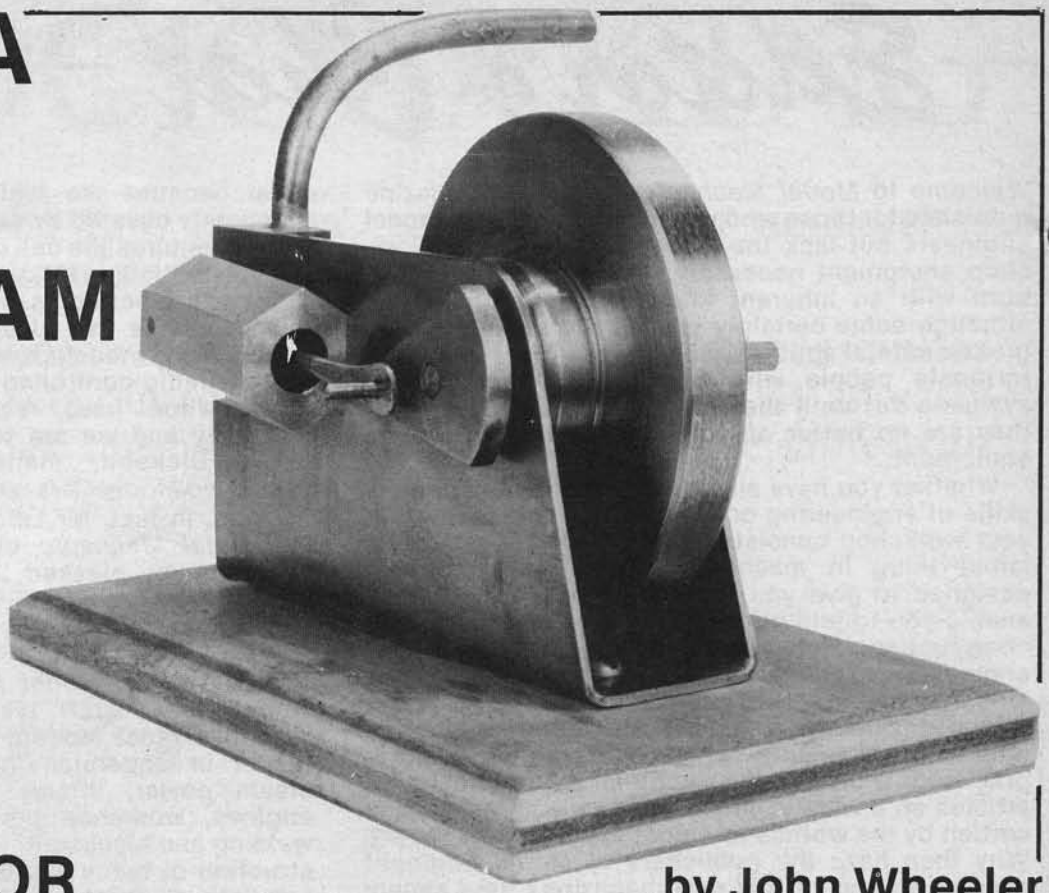
All the constructional articles will be aimed towards those readers with limited workshop facilities and where a lathe is required, one of the several small machines will be quite adequate. But we will not forget that many of you will have access to larger machines and also that many will eventually graduate to one of these precision lathes and a few words of explanation and encouragement on the finer points of workshop practice will be given from time to time.

Lastly we must not forget full-size practice. Although it is true to say in many cases models were built before the prototype was born, it is nowadays more accurate to accept that models are built to represent already operational machines. This is particularly true of steam where, regretfully, most of the full-size vehicles or engines are no longer with us. For this reason we are indebted to the preservation societies and museums for retaining — many in working order — samples of magnificent machinery which would otherwise be denied us. The full size article will therefore appear under several headings — perhaps through "Jim King's Travels", or even a "Prototypes Worth Modelling" page.

All that is left to do now is wish you happy modelling and a long, rewarding association with *Model Mechanics.*

Editorial Director R. G. MOULTON
Editor LES PORTER
Managing Director GOSPATRIC HOME
Group Advertisement Manager M. GRAY

MAKE A START IN STEAM



A SIMPLE OSCILLATOR

by John Wheeler

THIS ENGINE CAN easily be built using the minimum of machine tools — in fact except for the flywheel which requires a small lathe, it could be built using hand tools only.

Why is it called an oscillating engine? Because the admission and exhaust of steam to and from the cylinder is controlled by the oscillation of the cylinder which opens and closes the inlet and exhaust ports.

Look at Fig. 1, steam entering port 'A' pushes on the piston, turns the crankshaft and therefore the flywheel in the direction of the arrow. The piston descends in the cylinder and on reaching its lowest position, referred to as Bottom Dead Centre (B.D.C.) the energy given to the flywheel by the initial push keeps the flywheel turning in the same direction and helps the piston to rise in the cylinder; at the same time the cylinder has moved across (an oscillation) to close the inlet port and begins to open the exhaust port. The rising piston drives out the used steam through the now open exhaust port until the piston reaches Top Dead Centre (T.D.C.) when the ports are again closed. Once more the stored energy from the flywheel helps the piston pass T.D.C. and as the cylinder moves across, the inlet port begins to open letting steam in to start the power stroke again.

Of course if the inlet port was exposed as shown in the exhaust stage of Fig. 6, incoming steam, which is under pressure, would quickly vent off to the air and all the steam from the boiler would be lost. So we have to make sure that the inlet port at least is always covered by the cylinder port face at any part of the oscillation. For ease of assembly, and as ports are often made to be symmetrical, the exhaust and inlet ports are always covered by the cylinder in our design by the cylinder port face. At least we can then reverse the rotation of the flywheel by interchanging the inlet and exhaust pipes.

Two disadvantages of the simple oscillating engine are:

1 It cannot be classed as self-starting because it requires an initial push to the flywheel.
2 High pressures of steam cannot be used as they require excessive pressure from the pivot spring to seal the moving faces. In fact the spring acts as an excellent safety valve, letting the port faces lift apart if ever the steam pressure becomes too high.

This spring should be adjusted to give just sufficient pressure to hold the port faces in contact whilst running. Excessive pressure will increase the friction and slow the engine. Note how the cylinder port face on the design is filed away around the pivot spindle to reduce the contact area and therefore friction.

Mainframe Fig. 2

Mark out the shape on a piece of mild steel sheet, you could make up a cardboard template and draw round that but it is more workmanlike to mark out direct on the steel using a rule, scriber and centre-punch. It helps if you coat the steel with some marking out dye or layout fluid, then the lines really show up bright. Don't, however, use the scriber on the bend lines, here a pencil will be good enough to show the position of the bends. Now go all around the outline with light centre punch marks about ten — 15mm apart, closer on curves; these are called witness marks, often made with a light, sharp punch called a Dot Punch and will show the true position of the lines when you are filing to shape. You file to the half dot position indicating you have reached the line. Whilst the steel is on the flat, it is easy to drill the three marked holes 4.5mm dia. Centre punch first and remove the burrs afterwards using a twist from a countersink. The two holes between the lines AA and BB are to secure the frame to a wooden base using round head wood screws, and the third gives us the first position for the crankshaft bearing.

Hacksaw close to the line, don't use tinsnips or a guillotine as you will probably bend the metal, and remember hacksaw work is easier than extra filing, so hacksaw as close to the line as possible without cutting into the main shape and then file to the lines.

Now here's where those witness marks come into their own, as you file closer to the line, the line becomes part of the edge and the only indication you have on reaching the line is seeing *half* those dots still on your metal. That's why they should only be light punch marks, we don't want to see a pock marked edge. Finally go round the edge using a smooth file, finished by draw-filing to get rid of all those horrible cross scratches, and remove that burr! Now we can bend to shape, first along the line AA by clamping to the bench with a strip of wood up to the

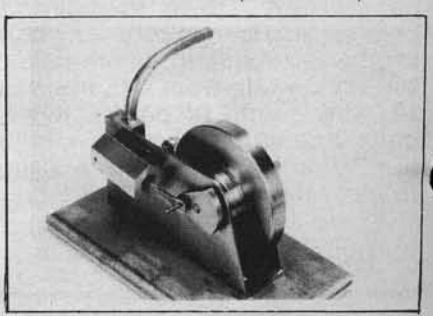
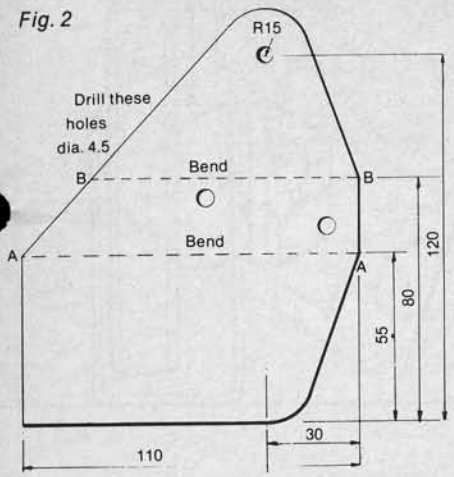


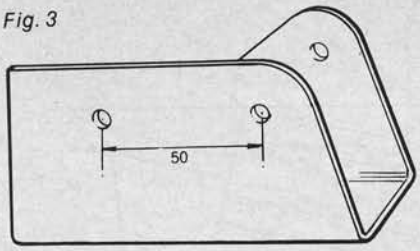
Fig. 2



line or using folding bars if available. Use a wooden or rawhide mallet to move the metal towards a right angle bend, cover the bend with a second piece of wood and some strong thumps with a heavy hammer should give you a sharp right-angled bend. Find another piece of hardwood 25mm thick, position to give the second bend BB, clamp in a vice and bend.

Whilst you have the 25mm thick piece of wood in place, use the already drilled 4.5mm dia. bearing hole as a guide to drill out the opposite side to 4.5mm dia. Check here for squareness and truth with the bottom face. Mind you, a vertical power drill will make life very easy here, but with care it can be done using a hand drill, not a hand held power drill, unless you want to end up with a flying mainframe and a broken drill bit, caused by the drill 'snatching' on breaking through the thin sheet. Now follow up with a 5.0mm dia. drill which should give a fairly accurate round hole. A good practice is to drill slightly undersize and then out to size for fairly accurate round holes. Mark out for the other 5.0mm dia. hole as shown in Fig.

Fig. 3



3 and drill as just explained. This will be a cylinder pivot and spindle hole. The main frame is now finished and should be screwed down to a polished piece of wood. Use brass round head wood screws, tighten down and arrange for those screwdriver slots to finish in line.

Crankshaft, crankweb and crankpin

Cut off a 60mm length of 5mm dia. mild steel rod, and square the ends with a file, that's the crankshaft, likewise for the crankpin, a piece of 15mm length steel, 3mm dia. The crankweb is a piece of flat mild steel about 3mm thick and 30mm wide, mark out two as Fig. 4, make two — it's just as easy and gives you a chance to improve the second one, always work the same piece first at each stage, that is the trial one, your second piece should then be spot on! Dot punch the outline and centre punch for the drilled hole positions. Drill the holes to match the crankshaft and crankpin diameters. Undersize first and then out to size. These holes are drilled whilst the metal is in the rectangular

Fig. 4

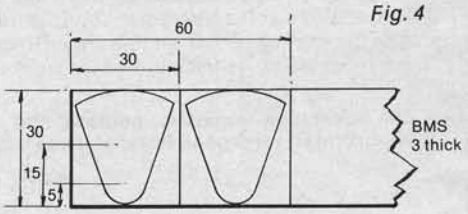
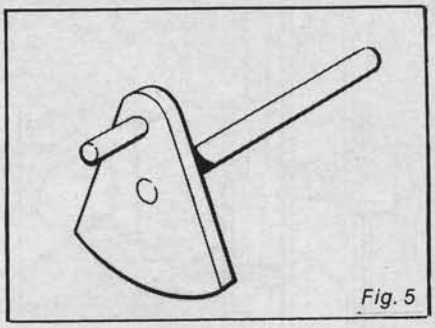


Fig. 5



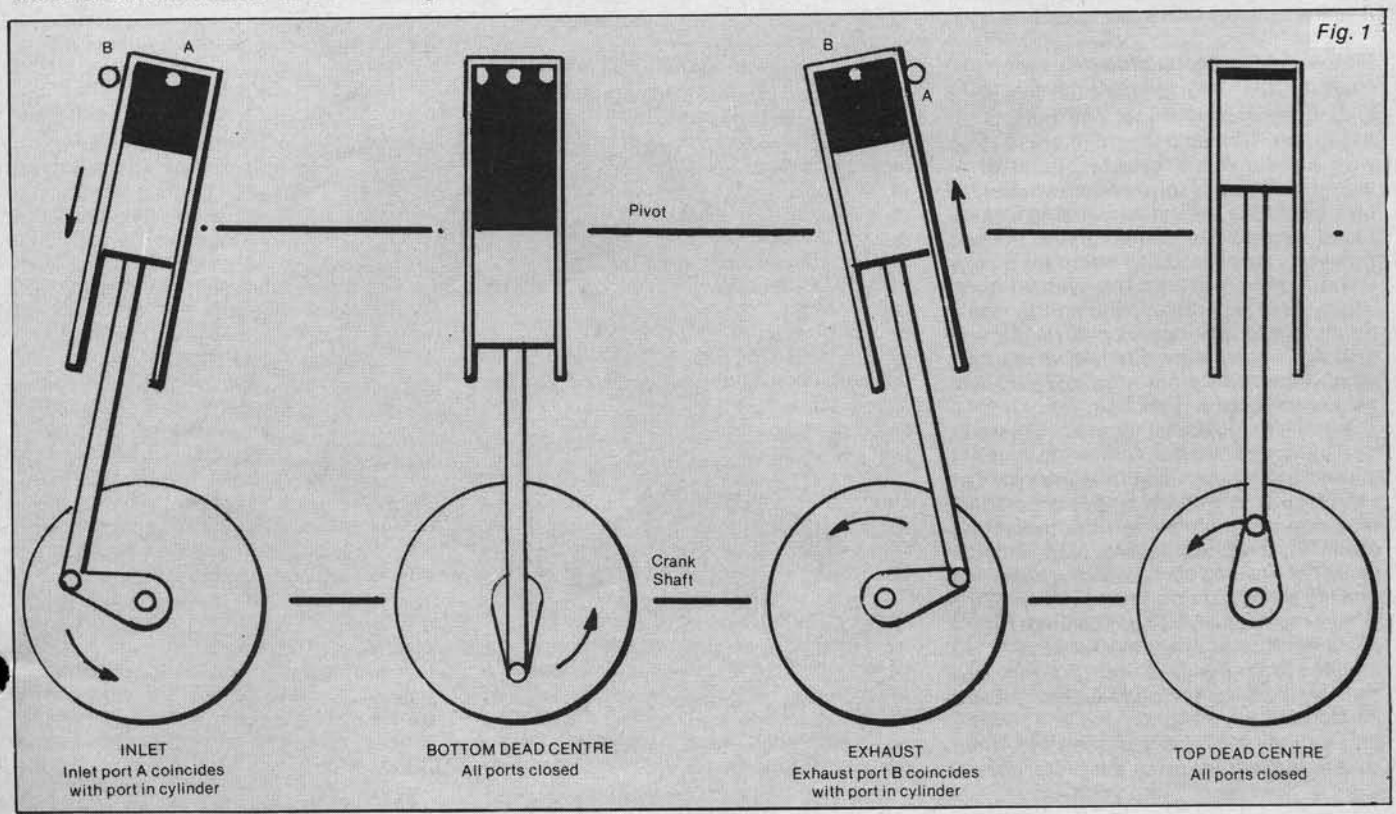
shape as it is easier to hold in the drilling machine vice; hacksaw and file to shape, clean up the edges. Fit the crankshaft and crankpin into the crankweb from opposite sides (Fig. 5) and soft solder in place or even use Loctite Super to hold in place, but clean off all traces of oil and dirt first. At least the crankshaft assembly should rotate in the mainframe and we are ready to make the cylinder.

Cylinder

A piece of hexagonal or square aluminium with sizes shown in Fig. 7 is required. Our piston will be of brass, but if only brass is available for the cylinder use aluminium or steel for your piston. These combinations work well together, don't be tempted to use the same metal for piston and cylinder as 'pick-up' and scoring of the cylinder will occur. That's the way to a sure 'seize-up'!

Cut off a 38mm length of your chosen metal, clean up the ends square to the length, here a lathe will help things along, but your filing should be up to this test. Mark out the centre on one end, set up vertically in the drilling machine vice, drill out to $\frac{23}{64}$ in. dia. and ream $\frac{3}{8}$ in. dia. or drill out to 9.7mm dia. and ream 10mm dia. Reaming is needed here to give a smooth round hole suitable to take a close fitting piston. If you have access to a lathe, hexagonal material is ideal for gripping in

Fig. 1



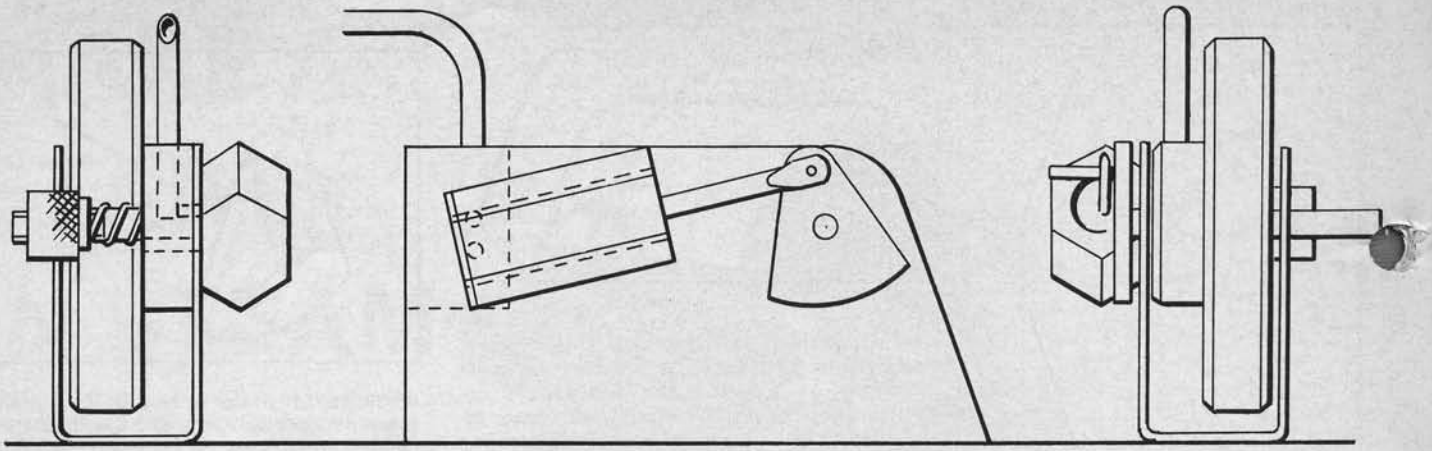


Fig. 6

the 3-jaw chuck, you can then face the ends, centre drill one end, drill through and follow up with the reamer. File off one flat face until its width is 14mm, aim for a smooth flat finish. Mark the centre of this long side, centre punch, drill and tap the thread M5, but don't break through into the cylinder and check that the tap commences square and true to the work. A cock-eyed spindle in the cylinder will not allow the port faces to remain in close contact when the engine is running. File away the centre area for approx. 8mm each side of the pivot spindle to a depth of ½mm. This should help to reduce friction. The steam port position is marked and drilled through 2mm dia. On setting up the engine we use this through hole for marking and drilling the positions of the inlet and exhaust ports, then block up the visible portion of the hole. The top end of the cylinder is closed by a turned or shaped piece of aluminium or brass, the same as the cylinder, and secured in place with Loctite or Araldite.

For the pivot spindle, a piece of mild steel, 35mm in length, 5mm dia. with an M5 thread cut on each end is prepared (Fig. 8). The short threaded end is screwed into the cylinder with a dab of Loctite.

Piston and Connecting rod

Any piston on an engine must be a good sliding fit in its cylinder and ours is no exception. Turn up a length of brass to go with an aluminium cylinder, or steel or aluminium piston for a brass cylinder, to be a tight fit in the cylinder. Using a sharp round nose tool in the lathe, turn the two grooves, now carefully skim to give a smooth sliding fit into the cylinder bore, use a sharp well-radiused toolbit to give a good finish. Face the end, centre drill, and drill and tap M4 for a depth of approx. 8mm. Remove from the chuck and hacksaw off overlength.

If you have no lathe then you will have to find a piece of brass or aluminium which is already a smooth sliding fit in the cylinder, cut off over length and gripping carefully in a vice, possibly using fibre protecting jaws, file the ends square. Mark out the centre of one end very carefully, hand drill and tap M4 whilst upright in the vice. Then when you make your connecting rod, a spare short end threaded M4 and fitted into the piston will let you grip this in a hand drill, whilst the hand drill is gripped horizontally in the bench vice. Turn the drill with the left hand and rest a 4 in. three square file, corner on to the piston which is on the right hand side of the bench vice. Your right hand controls the cutting tool which in this case is the file and produces the Vee's whilst your left hand is the motive power. Do make sure the work turns over the top towards you just like a lathe. A final smoothing over the surface with a dead smooth file should make that piston slide smoothly in its cylinder bore.

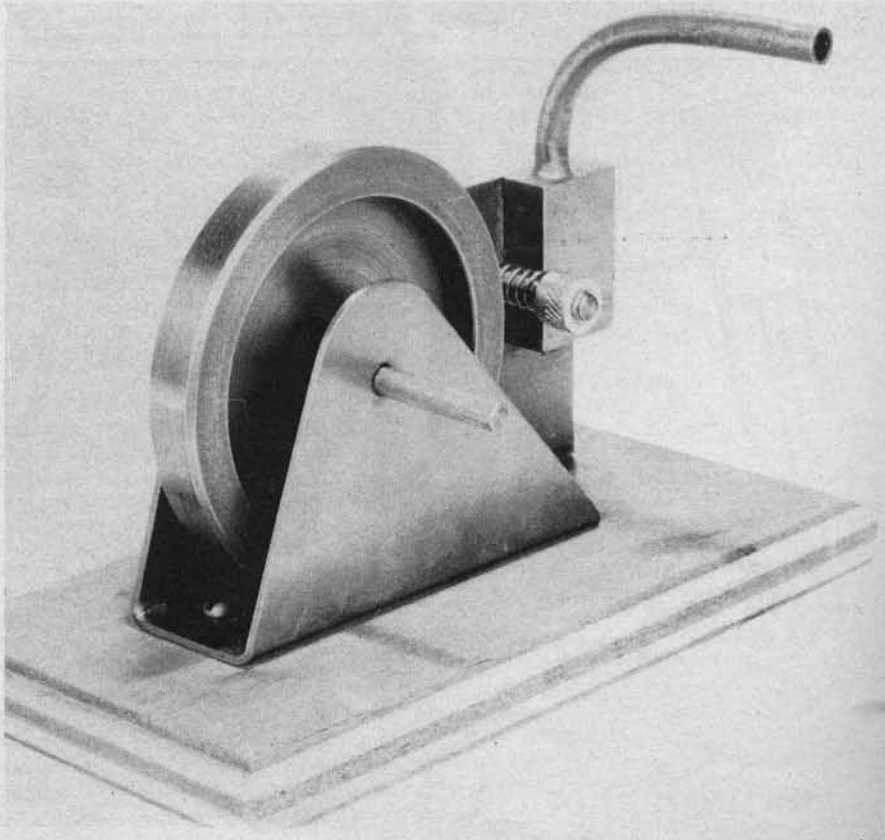
Whilst the piston is fitted to that short piece of brass rod, and can be gripped in the lathe 3-jaw chuck or the hand drill set up as a lathe, you can carefully clean up what will be the top face of the piston. We make the connecting rod from brass 4mm dia., length 45mm. Flatten one end, file to shape and drill 3mm dia. (Fig. 9). Begin to thread the other end M4, the final length is adjusted when the engine is assembled.

The port block is a piece of mild steel 30 x 30 x 10mm soft soldered or Loctited into the top corner of the engine main frame ready for the ports to be drilled into it.

Flywheel

The flywheel really should be turned in a lathe to run true and smooth. You require a piece of mild steel 60 or 70mm in diameter and 20—25mm length. Grip in the 3-jaw chuck, face the end and turn down to give a shoulder 30mm dia. by 10mm length. Form a small chamfer using the left hand side of a Vee tool. Reverse in the chuck and grip by the 30mm diameter, face the end and turn the outer rim true to a suitable diameter, form a small chamfer on each corner as per drawing. Centre drill and drill through 5mm diameter to fit the crankshaft. By working this way, making the outer dia. and drilling the hole at the same setting we make certain the rim of the flywheel runs true when fitted to the crankshaft. A wobbly flywheel gives a poor impression of what could be a good engine. Furthermore a good flywheel has all its mass at the periphery, so if you are able, bore out the centre to a depth o

The oscillating engine is, perhaps, the most basic of all steam engines as there is no complicated valve gear. Future issues will feature more complex engines.



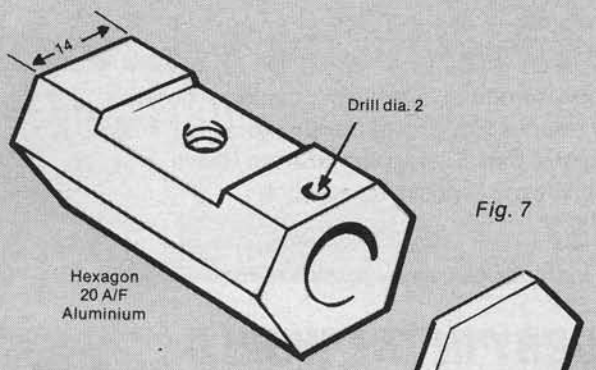
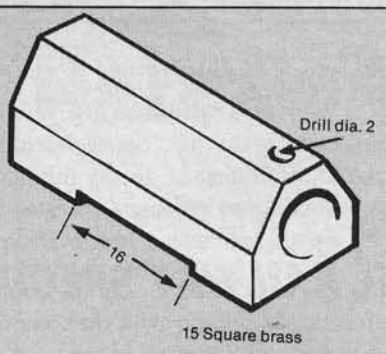
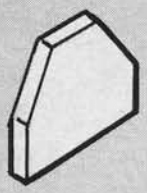


Fig. 7





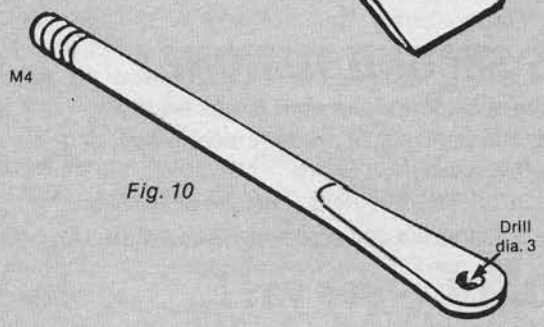


Fig. 10

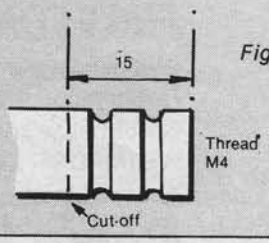


Fig. 9

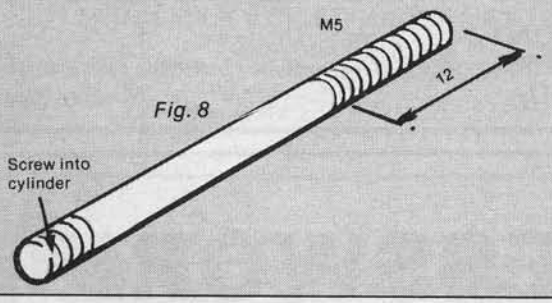
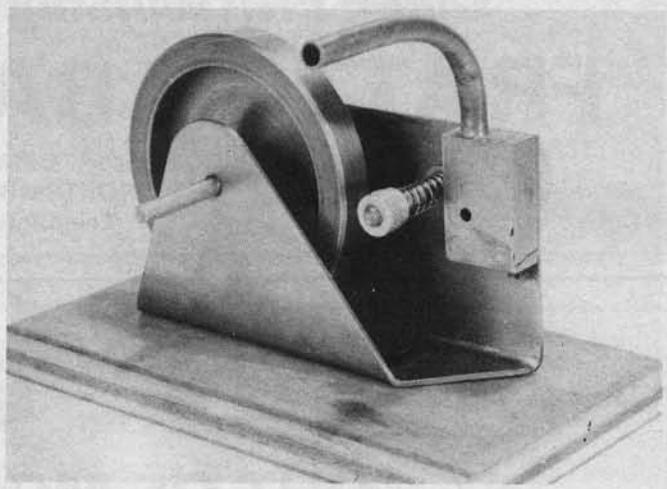


Fig. 8



This view clearly shows the steam inlet pipe and the hole for the exhaust. Note also the knurled adjusting screw and spring.

10mm leaving a rim thickness of 10mm before removing from the chuck. Now set up in a machine vice and drill and tap M4 for the grub screw.

Assembly

You now have a choice, paint first, then assemble and try running or assemble, run, adjust, strip down, paint and then reassemble. I prefer the latter as small modifications can easily be made without the worry of damaging the paint finish. Fit a small washer behind the crankweb, slide the crankshaft in through one bearing, through the flywheel and into the other bearing hole. Now fit an M4 grubscrew to secure the flywheel onto the crankshaft, so that there is very little side movement. A slight dollop of oil makes the crankshaft and flywheel rotate smoothly.

Oil the piston, slide into its cylinder and fit the spindle into its bearing hole with more oil, find or make a compression spring 20mm long and fit with an M5 nut or turn a knurled adjusting nut, so holding the cylinder against the engine frame whilst fitting the connecting rod over the crankpin. Turn over using the flywheel and adjust the length of piston rod, screwing it further into the piston, even cutting a longer M4 thread so that the piston nearly touches the closed end of cylinder at T.D.C.

Setting out and drilling the ports

Turn the crankweb to a position where the piston rod crankpin and centre of crankshaft makes an angle of 90° (see Fig. 1 inlet power stroke), clamp in this position and using the 2mm dia. hole in the cylinder as a guide drill through into the port block, drill a hole suitable for the copper inlet pipe to meet this 2mm hole. Solder or Loctite the inlet pipe into place.

Position the cylinder, piston rod, crankpin and centre of the crankshaft to make the other angle of 90° (Fig. 1 exhaust stroke) clamp again and using the 2mm dia. hole in the cylinder as a guide, drill 2mm dia. hole right through the port block, giving the exhaust port. Fill the 2mm hole in the cylinder, which was used for setting up, not the hole at the port face, with a small tight fitting plug of aluminium wire aided by Loctite, or just fill with Araldite when you fit the cylinder top cover.

Happily you can now connect up the inlet pipe to a low pressure compressed air supply, about 5—15 lb. per square inch will do, give the flywheel a flick and the engine will buzz away. Keep plenty of oil on all moving surfaces and adjust the spring pressure on the cylinder to give the fastest revolutions possible with no loss of air from between the oscillating port faces. The engine will run smoother when all surfaces have had time to bed in. When 'running in' is completed, strip down, clean off all oil and dirt and paint. Suggested colours are dark green engine frame, red crankweb, a black flywheel with a bright metal rim and red inside surfaces and natural polished surfaces to the cylinder and piston rod.

Later on when running using steam, ensure that the rubbing port faces and piston receive plenty of oil. Further increase in power and speed can be obtained by adjusting the inlet and exhaust port positions or shapes. However I'll leave that to you because I'm sure that once you have made this engine you will want to try putting two together in a Vee formation or opposing one another in an attempt to make it self starting, the parts are so simple very little time is wasted if an item is spoilt. Just make another!

Hi Folks!

Thought we'd look in on this "house warming" and introduce ourselves. Looking around us we are tempted, at first sight, to say this is really not our scene. Apart from stocking Tamiya Plastic Kits, Mamod and Wilesco Live Steam Engines, plus Scalextric and Auto Rallye Road Racing we are not really a model shop at all. We are almost exclusively a

MODEL RAILWAY SPECIALIST

— but then we realise all the skills demonstrated in this book come together in modelling Model Railways which, after all, is the

SECOND MOST POPULAR HOBBY IN THE WORLD

(SECOND ONLY TO ANGLING)

and in Model Railways

FRATTON BARGAIN SHOP IS SECOND TO NONE!

(We handle all makes and gauges, ready to run kits and spares. Our staff is trained to Fleischmann Advanced Course Standard, keep to the forefront of modern technology, and will dispense knowhow, advice or the most complex repair.)

WE IMPORT, EXPORT AND MAIL ORDER ALL OVER THE WORLD. The use of Eurocard, Access, Mastercard or Barclaycard facilitate phone ordering. *So any time you are down this way*

Come Frattonising Folks — see ya!!

FRATTON BARGAIN SHOP

Hours: 9—6 (8 Fri.)
Open Lunch Hours

165-173 FRATTON ROAD
PORTSMOUTH PO1 5ET
Telephone (0705) 27117

Ample Free Parking
Six Day Week

TAKE THE GUESSWORK

OUT OF MODEL MAKING

VARISCALE LTD

66 Ashton Road · Ashton Gate · Bristol

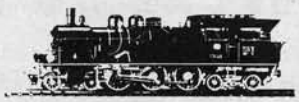
Variscale Ltd can reproduce your plans to any scale required on paper or film (clear or Matt surface). Photographic reproductions can be made from any original, whether it be small books, magazines or original drawings with a while-you-wait service or by return of post.

Any section of plans can be enlarged or reduced to an accurate scale, thereby saving you time and headaches on redrawing.

Telephone: (0272) 632885

HADLEY HOBBIES

The Railway People



FULGUREX DB Br 78/SNCF 232TC 4-6-4 tank loco now in stock. Superb Gauge "1" scale model spirit fired kit and ready to run (subject to exchange rates). Free electric blower fan and water pump. Features copper tubed boiler lagged in brass, pressure gauge, water gauge. Walscaert motion with working cab reverse gear lever, lubricator, regulator, blower. Also stocked Aster Schools PLM (very few left, will not be made again!) Shay, Reno Rolling test track £108.00. Aster rolling stock — track.

What ever you Model Railway needs from Ready to Run to Handcrafted collectors' items — We are well worth a visit!

Access - Barclaycard - Visa - Diners Card - American Express HobbyCard

131 MIDDLESEX STREET, BISHOPSGATE, LONDON E1

Close Liverpool Street Station **01-283 9870**

OPEN SUNDAY 9.30am - 2pm MONDAY - FRIDAY 9am - 6pm

HADLEY HOBBIES

for R/C Cars - Boats - Aircraft - Helicopters

ASTER LIVE STEAM TUG BOAT

Pre Painted all Metal Hull and Fittings for easy self assembly — no soldering.
Three cylinder spirit fired steam engine with reverse — Ideal for Radio Control.

We specialise in radio — Big stocks and special prices on Futaba — McGregor — Sanwa — Multiplex

Enormous range of kits, engines, materials, parts, books, tools, etc.

A VERY SPECIAL WELCOME FOR OVERSEAS VISITORS
Personal exports and overseas mail order tax free.

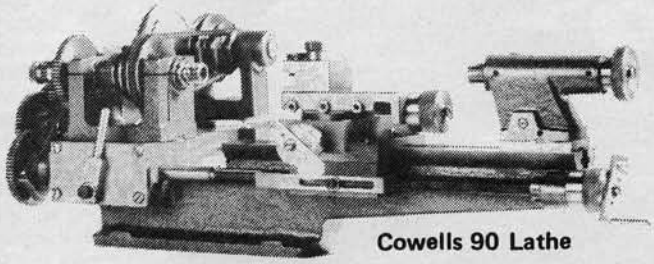
Access - Barclaycard - Visa - Diners Card - American Express HobbyCard

131 MIDDLESEX STREET, BISHOPSGATE, LONDON E1

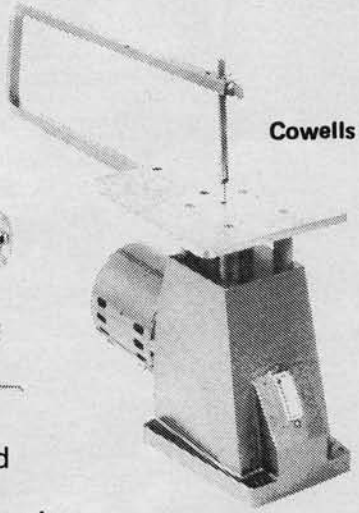
Close Liverpool Street Station **01-283 9870**

OPEN SUNDAY 9.30am - 2pm MONDAY - FRIDAY 9am - 6pm

The Cowell Range of small machine tools



Cowells 90 Lathe



Cowells Jigsaw

Cowells Miniature Drilling Machine

Precision machines for the modeller, craftsman and engineer Of rugged construction they are ideally suited for use in schools and occupational therapy units.

For full details of these fine British made machine tools please write or telephone:—

Holders may telephone their order

COWELL ENGINEERING LTD

120

95-101 Oak Street, Norwich, England NR3 3BP.Tel: 614521 (STD 0603) Telex 975205

TOOLS OF THE TRADE

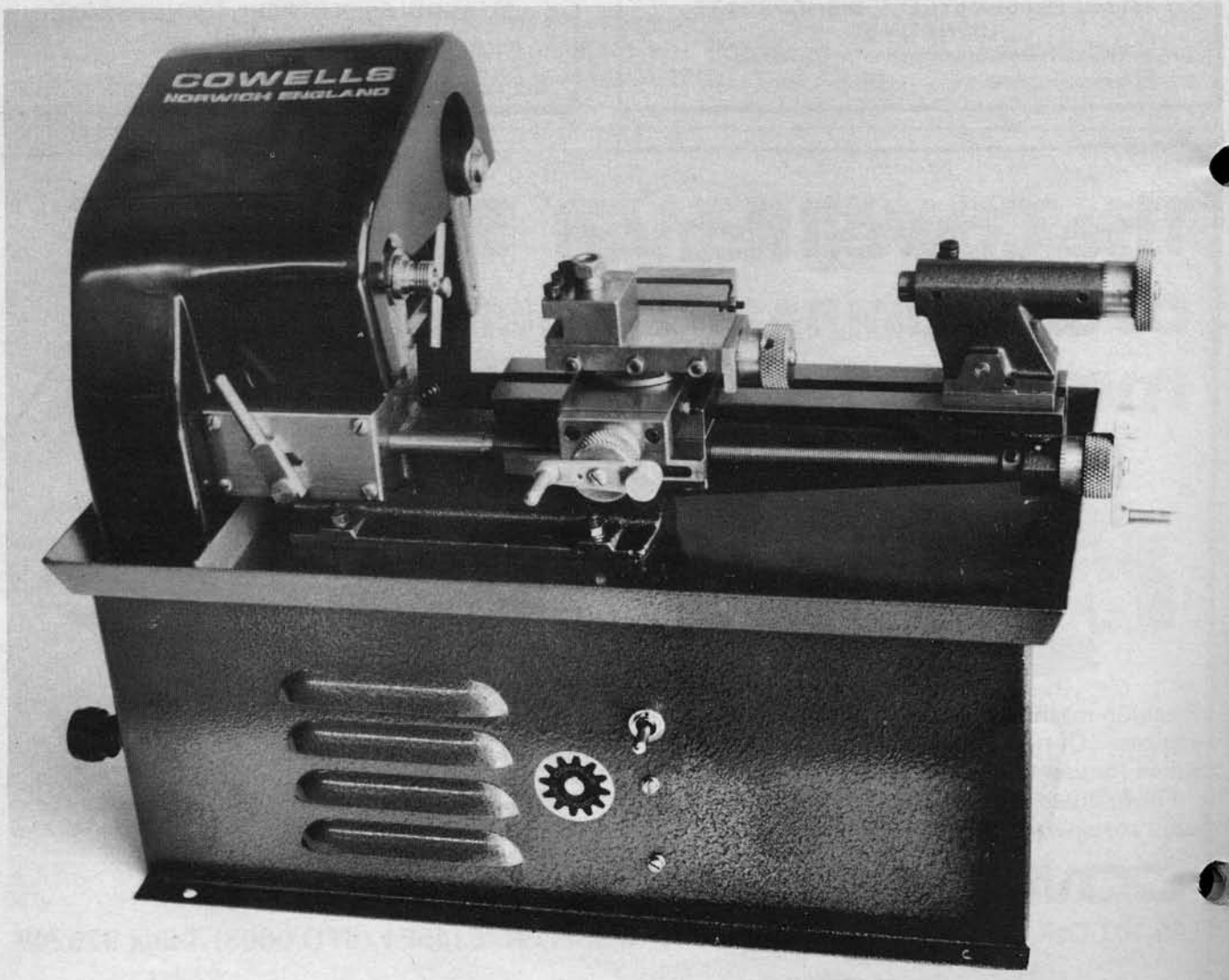
JIM KING LOOKS AT THE COWELL 90 LATHE

IN AN AGE when living accommodation is at a premium and many hopeful model engineers are living in apartment blocks where self-contained workshops are just another pipe dream, the advent of another small capacity lathe capable of being used and stored in a restricted space in a manner akin to that of the domestic sewing machine will be of interest to many. Another blow, perhaps, for sex equality for the male population? Not that the market has no other machines available to cater for this need, but the lathes generally on sale in this class and size are of continental origin and it is a market that in recent years has not had a British product to interest the potential customers.

The Cowell 90 is a lathe designed as a serious competitor in this market, one that has an ever-growing number of potential customers with the constant increase in general leisure time and activities, and one that will interest many who like to buy British if the product is as good as the overseas competitor. Original design of the machine was by Brian Perris who brought the lathe into production with several other small tools designed for this same market. Several years of hard work saw the Perris Company in a very sound position but all efforts came to an end when Brian Perris died on the way home from the 1976 Model Engineer Exhibition. Soon after the company folded and most people thought that this was the end of the line for these products, and indeed for a period the whole project was in a state of limbo until Sid Cowell of Norwich acquired the assets which included the remaining stock and the patterns. The machines were put back into production and made a welcome re-appearance at the 1977 Model Engineer Exhibition and to prove that business was meant, Cowells had a stand again in 1978 and will be regular exhibitors in the future displays.

So once again there is a British small lathe back on the market and it is already selling to the capacity of the manufacturer, for like so many other engineering companies, capacity is only restricted at the present time by a scarcity of skilled workers, and so there is a short waiting time in delivery. Hopefully this time will diminish until over the counter sales will be possible and already Cowells are setting up a network of agents so that prompt delivery of orders can be made.

What then is the specification of the Cowell 90? There can be no better way initially than to repeat that given in the Cowell Catalogue. The lathe is built in the traditional way of many larger machines with a cast iron cantilever bed. In fact all major castings are of high grade cast iron and in the machine now in use by the writer, are well-finished and have been well "seasoned" in store while awaiting



final machining. Machine tolerances are close and gib strips are fitted on the moving slides to give adjustment in use. But why talk about details when we were going to lay out the Specification for you? So here it is:—

Speed range using 1450 motor with 25mm (1") dia. pulley			
Ungeared	880	500	280
Geared	188	107	60
Speed range with high speed bearings, free running speeds			
High ratio	7500	4260	2430
Low ratio	830	470	270
Spindle Nose Thread	14mm x 1.5mm Pitch		
Spindle Bore	6.4mm (¼")		
Spindle and Tailstock Taper	'0' Morse		
Cross Slide Travel	89mm (3½")		
Compound Slide Travel	38mm (1½")		
Tailstock Barrel Travel	32mm (1¼")		
Centre Height	44mm (1¾")		
Distance Between Centres	200mm (8")		
Swing Over Bed	88mm (3½")		
Swing In Gap	120mm (4¾")		
Swing Over Cross Slide	47mm (1⅞")		
Speed range using 1725 RPM motor with 25mm (1") dia. pulley			
Ungeared	1042	592	332
Geared	222	126	71

As can be seen, a number of options are available for the basic lathe, it can be bought with or without a motor, motors are available for most voltages and there is a version with bearings suitable for the high speed needed for clock-making and the like. Some may find it a disadvantage that the machine is very much with it in having metric threads but this is not so as ISO threads will serve most purposes in the model, light engineering and instrument making worlds.

Accessories

To complement the lathe there is a full range of accessories, vertical slides, steadies, tailstock chucks and very good three- and four-jaw chucks made exclusively for Cowells by Pratt-Burnerd. Of course, like all machines, when it first appeared the Cowell 90 was not perfect, there are always improvements and extras to be made to any basic design and this was no exception. Already minor changes have been made, the original Perris-designed handles have been discarded and all current models are fitted with a better type of hand wheel. For the customer with the original handles a replacement will be supplied at a nominal charge. The motor case and covers are also being modified in the light of users' experience and it is the hope of Cowell's that users will let them have a continuing flow of information as to how they find the lathe in use.

The manufacturers say that the lathe can be mounted on a board and stood on any convenient surface to use. Being used to having machine tools no matter how small, firmly bolted down I was sceptical at first but after bringing the lathe from Norwich and fitting a 13 amp. plug, the lathe was placed on the dining room table and a piece of mild steel about 3 in. long and ¾ in. diameter was reduced down to ¼ in. without any problem. It would be advisable, though, to place a piece of hardboard under the machine and also to clamp any mounting board down as some movement will take place due to vibration. A good idea also is to have the vacuum cleaner handy in case you get chips or swarf on the floor for you know how funny the womenfolk can get.

Proof of the robustness of the Cowell 90 was provided within a few days of its acquisition when it was loaned to the St. Albans Society for use during their exhibition and it was just left for anyone to use. Screwed down, of course, to prevent any bright ideas of the light fingered brigade, it was worked all three days without any problem.

So much for a first appraisal of the Cowell 90 and it can be assumed that in the coming months there will be a lot of work found for it, so that any improvements can be suggested to the manufacturer and also some of those smaller turning jobs that have been awaiting my retirement can be completed. First jobs will be a couple of Stuart No. 10s for marine use and these have been selected firstly because I have an immediate use for them and, secondly, they would appear to be the largest traditional type of engine that the Cowell 90 can handle with comfort and it will prove of interest to see how the machine performs while doing the job. Perhaps when some progress has been made the Editor will find space for a resumé of the work.

Iris Phelps using the Cowell 90 lathe.

Prices:

Model 10-200	**£154.15**
Model 10-200A	**£173.43**
Model 10-200B	**£246.85**

These prices are excluding motor, faceplate and chucks. Other accessories will be required.

FOR EVERY ASPECT OF MODELLING!

A choice of two drills, P1 and P2, that fit snugly in the hand, so light they enable you to carry out the most intricate tasks — drilling, shaping, cutting, polishing, etc., in the minimum time. The new dual-purpose transformer (shown with P2 in cradle) supplies the D/C voltage at the correct rating for either drill, and the full range of accessories fill almost every need. P1 DRILL £10, p.p. 38p.; P2 DRILL in case £19.50, p.p. 86p. TRANSFORMER (variable speed) £12.50, p.p. 81p.; ACCESSORIES 40p each, p.p. any quantity 25p. Send 9" x 4" S.A.E. for full details.

PRECISION PETITE DRILLS

119a HIGH STREET TEDDINGTON MIDDLESEX TW11 8HG TEL: 01-977 0878

FIELD ELECTRIC LTD

3 SHENLEY ROAD, BOREHAM WOOD, HERTS WD6 1AA
Tel: 01-953 6009

Solenoids

1½ volt, size 25 x 26 x 10, 20 gms pull . . . each	15p +	24p post
12 volt, size 35 x 19 x 24, 3 klo's pull . . . . . each	70p +	24p post
24 volt, size 40 x 13 x 14, 600 gms pull . . . each	25p +	24p post
240 volt, size 50 x 16 x 18, 500 gms pull . . each	65p +	24p post
240 volt, size 68 x 25 x 31, 3.5 klo's pull . . each	80p +	24p post

Model Motors

1½ — 4½ volt, 10 motors	£1.20 +	25p post

Mains Motors 250v. A.C. Reversible

¼ h.p. 1440 r.p.m.	£12.25 +	£2.00 carr.
½ h.p. 1440 r.p.m.	£19.98 +	£2.00 carr.

Geared Motors

1 r.p.m. 250v. A.C. c/c/wise, 4 klo c.m. . .	£3.00 +	20p post
73 r.p.m. 250v. A.C. reversible, 1.3 lbs. ins.	£6.50 +	80p carr.
150 r.p.m. 250v. A.C. c/wise, 600 gms. c.m.	£4.50 +	60p post
35 r.p.m. 250v. A.C. c/c/wise, 12 ft. lbs. .	£13.50 +	£2.00 carr.

Gear Boxes

60:1 reduction right angle box	£2.20 +	56p post

Relays

Contacts / Rating		
450Ω 12v. D.C., 5.P.C.O., 5 amps. 240v. A.C.		
700Ω 17-37v. D.C., 4.P.C.O., 2.5 amps. 120v. A.C.		
125Ω 10-16v. D.C., 4.P.C.O., 5 amps. 240v. A.C.		
All same price	55p +	15p post

Micro Switches

Contacts / Type		
5 amp. 240v. A.C., 5.P.C.O., V11	50p +	15p post
15 amp. 240v. A.C., 5.P.S.T., VBF	30p +	15p post
5 amp. 240v. A.C., 5.P.C.O., CR1	75p +	15p post
15 amp. 240v. A.C., 5.P.C.O., SB2	£2.25 +	15p post

Push Button Type

Red button, 5 amp. 240v. A.C. 5.P.C.O.	50p +	15p post
Green Button, 5 amp. 240v. A.C., D.P.C.O. .	£1.00 +	15p post

ALL PRICES INCLUDE V.A.T.

microflame
Miniature Gas Torch

- Great for Hobbies and Household Repairs
- Brazes and Solders
- Lifelong Plastic Carrying Case

FROM ALL GOOD MODEL SHOPS

4400 Deluxe Set

Sole Distributors:
MICROFLAME (U.K.) LTD.
ABBOT'S HALL, RICKINGHALL, DISS, NORFOLK
Tel: (037 989) 555-6

£25.92 TAX PAID

FIRST CLASS

tools, castings & materials

For steam LOCOMOTIVES
For steam CARS
For steam BOATS
For FARM CARTS
For ALL TYPES OF MODEL WORK

Steam Locomotive Designs from O' to 7¼ Gauge
Locomotive Designs and Fittings
Catalogue 40p post free U.K., Overseas £1
Small Tools and Materials Catalogue 40p post free U.K., Overseas £1

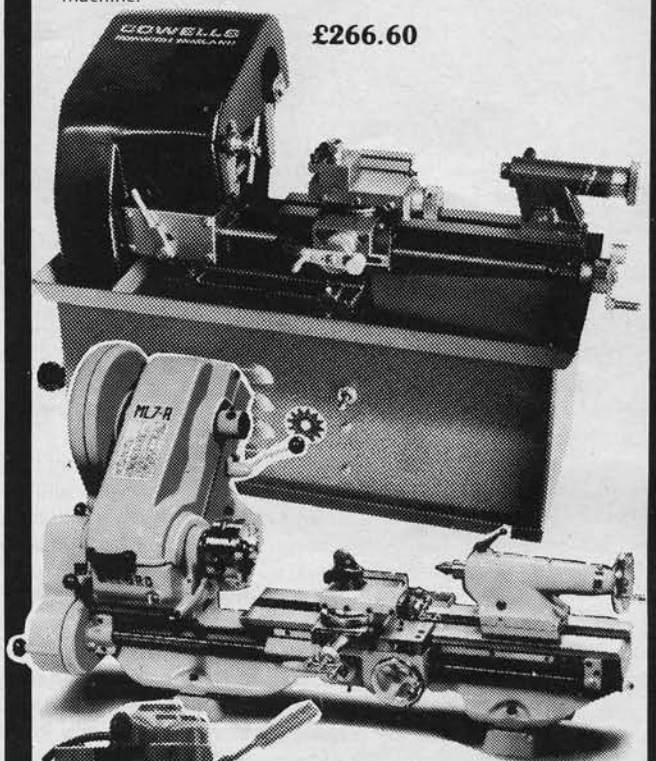
Stocks of Taps, Dies, Drills, Copper Brass and Steel Rivets, Rods, Bars, Tubes, Sheets, Bolts, Nuts, Washers, Springs, in Steel, Brass, Copper, P.B.

CHARLES KENNION
2 Railway Place, Hertford, Herts.
SG13 7BT
Telephone 52573

Open Monday to Saturday inclusive.

Build up your own Modelmakers Machine shop!
with John Hall Tools

COWELLS 90 LATHE
4¾" swing in gap. 8" between centres. 60 - 880 RPM. Suitable for screw and gear cutting, milling slots and keyways. Wide range of optional extras available to further enhance the versatility of this machine.



£266.60

MYFORD ML 7R LATHE
10" swing in gap. 19" between centres. 27 - 2105 RPM. For all those turning and milling jobs the modelmaker requires. With its range of optional accessories this machine becomes the complete metal working unit. **£557.28**

COWELLS MINIATURE DRILLING MACHINE Chuck capacity .344mm (No.80) to 3.97mm (5/32"). Maximum drilling depth 19mm. Table 90mm. diameter. Motor ⅛hp. Approximate free running speed 10,000 RPM. A small high precision machine capable of drilling small precise holes in a variety of materials. **£80.73**

¼" square drive socket sets
17 piece BA set 0 - 10BA
17 piece metric set 4 - 12mm
17 piece A/F 5/32" - ½" **£6.95**

Set of 5 jewellers screwdrivers **£1.57**

Burgess No.72 Hobbyist Engraving and Carving Kit RRP **£12.90**
our price **£9.95**

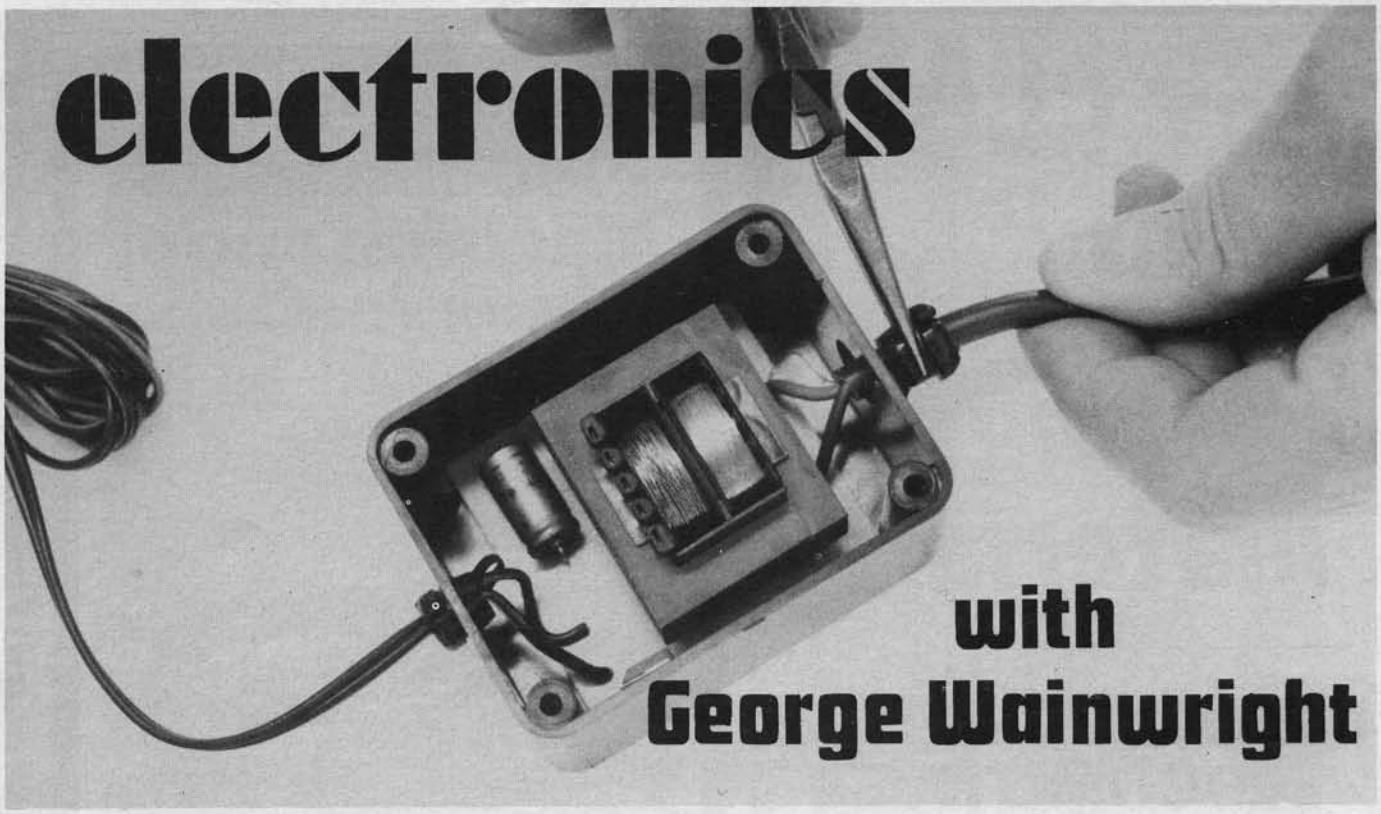
All prices inclusive of VAT

For further details please contact:—

John Hall Tools

BATH	2 Railway Street BA1 2AE (0225) 4513
BRISTOL	4 New Queen Street, Bedminster BS3 4BP (0272) 662664 (Off Whitehouse Street)
CARDIFF	22/24 Morgan Arcade CF1 2AF (0222) 396039
LEICESTER	Russell Square LE1 2DR (0533) 50671
LONDON	88-92 Merton High Street SW19 1BD 01-542-6644
NEWPORT	51 Commercial Street NPT 1LP (0633) 58004
SWANSEA	31 Kingsway SA1 5LH (0792) 55841

electronics



with George Wainwright

I REMEMBER BACK in the later years of World War II my interest in Electronics was first aroused, in those days it was called Wireless or maybe radio. My parents and others of the older generation had little help to offer as they had other interests, so those initial years were ones of experiment and failure, and occasionally success. However, the success was usually more good luck than a result of knowing what I was actually doing.

Some sort of line must be drawn between the aspects of Electronics as a hobby and therefore something to enjoy and a need to do some research into the subject to gain a basic knowledge of what it's all about. A hobby of this sort is essentially of a practical nature so we must find out what is really needed in order to get started. Something to build is a very good starting point as this will focus the interest in a positive manner with an end point to set our sights on. There are very many designs around for various 'Electronic' gadgets which will be gone into in greater detail later.

A theoretical circuit diagram may be fine for an engineer with experience but it is almost useless for a real beginner — so where do we start?

Tools

On the practical side we need the tools for a workbench. I have found a very more specialised equipment which will come later on; but screwdrivers and a soldering iron. Try to obtain some room for a workbench and I have found a very good one can be made out of an old door on a 'speed frame' stand fastened to a wall. Try to avoid a garage unless some form of heating can be employed as electronic components and damp don't mix.

You will see from the photograph some of the tools that will be needed from the beginning. Let's look at these tools in more detail. We will have mechanical work to do, sometimes much more mechanical than electronic, so these tools first. A set of screwdrivers with plastic handles of both the conventional and Philips or Pozidriv type and try to use the right Pozidriv size for the screw in question. It's quite easy to chew up a Pozidriv 'slot' with the wrong screwdriver size. Spanners are better than pliers to hold nuts and whilst more and more metric sizes are being used there are still a lot of BA sizes around so a set from 0BA — 8BA and similar metric sizes would be a good idea.

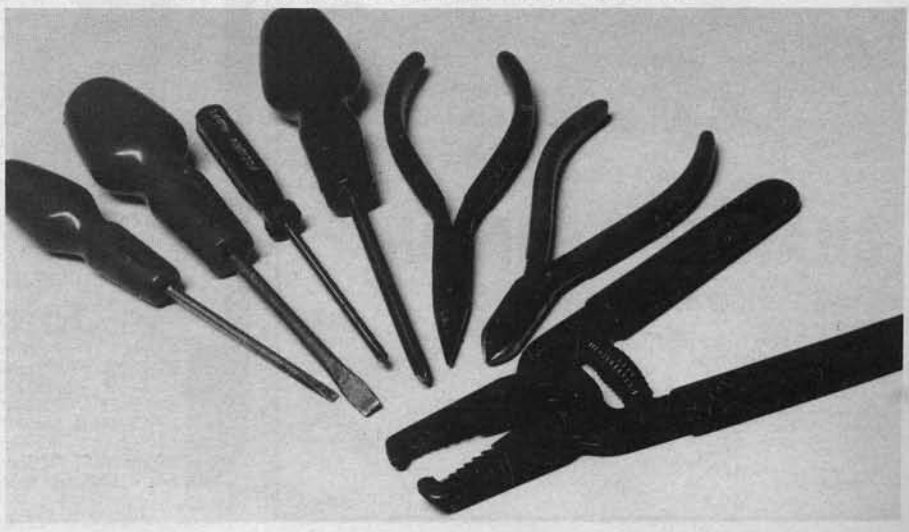
The pliers I mentioned should be of the 4 in. pointed nose type which will find uses in forming wire ends, placing nuts on screws and generally getting into places where fingers won't go.

Soldering

Soldering, now that is almost a subject in itself. Buy a good iron with a fairly fine 'bit'. I suggest a 15 or 25 watt iron such as the Adcola, Antex or Weller. All make a reasonably priced iron equipped with an iron coated copper bit which is pretinned. This type of bit, as opposed to pure copper, does not need to be filed to preserve its shape as new, just a wipe on a moistened cloth or sponge.

An ordinary copper bit tends to slowly dissolve under the continued action of solder and flux necessitating frequent filing in order to maintain a clean tip essential for good soldered joints. Talking of good soldered joints — use only a resin cored solder such as Multicore Ersin of medium gauge — say 20 swg. The flux

Screwdrivers, pliers, side cutters and wire strippers.



needed for good soldered joints is contained in the solder rather like the name through a piece of seaside rock. Any other additional flux is not necessary and may indeed by very harmful to electronic components and must be avoided.

Let's now look at soldering itself. Try twisting pieces of copper wire together first and, as you will see from the illustrations, obtain a good joint.

What we are trying to do is heat up both parts to be joined at the same time and also cause the solder to flow from the iron to each part. The iron must not remain on too long or delicate parts will be overheated and damaged. Also the iron must not be removed before time or a 'dry' joint will be the result.

To assist in avoiding a 'dry' joint, which really means one where the solder has failed to flow properly giving a crystalline effect, we rely on the flux within the solder. Imagine trying to thoroughly wet your hands without soap — it just doesn't work properly.

So placing the soldering iron against both parts (our twisted copper wires) and at the same time applying a little solder to bridge the contact between iron and wires will also release some flux as the solder melts, this will immediately cause the solder to flow around the 'job'. Whilst observing that this has taken place, try to remove both solder and iron at the same time. If the iron is left on the joint for a while after the solder is removed we use up the active flux and the joint then tends to be less than perfect. Keep trying until you feel you have the hang of it.

I now suggest that a move to a slightly more practical form of joint is made, still in a practice mode however.

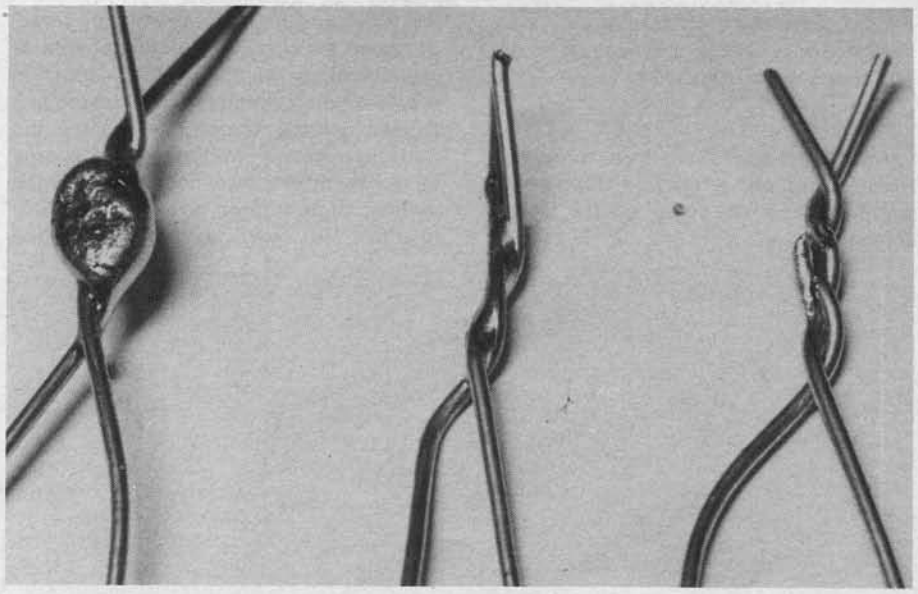
Circuit Boards

Obtain a piece of 'Veroboard'. This is a piece of printed 'circuit board' designed for the experimenter and, whilst we will talk about circuit boards later, soldering of wires and parts to these is essential at this stage as it forms such a basic part of soldering itself.

'Veroboard' consists of strips of copper bonded to a synthetic fibre base about $\frac{1}{16}$" thick. Each strip is pierced with holes about 1mm dia. Make small wire hoops like 'U's and place, say, half-a-dozen of these through any holes so that the ends stick out on the copper side. Bend the legs over at about 45° and try soldering in the same way as already described for the wires. Place the iron so that it touches both the copper strip and the copper wire and bring the solder to them both at the same time. Allow, as before, just enough time (2-4 seconds) for the solder to flow then remove both iron and solder.

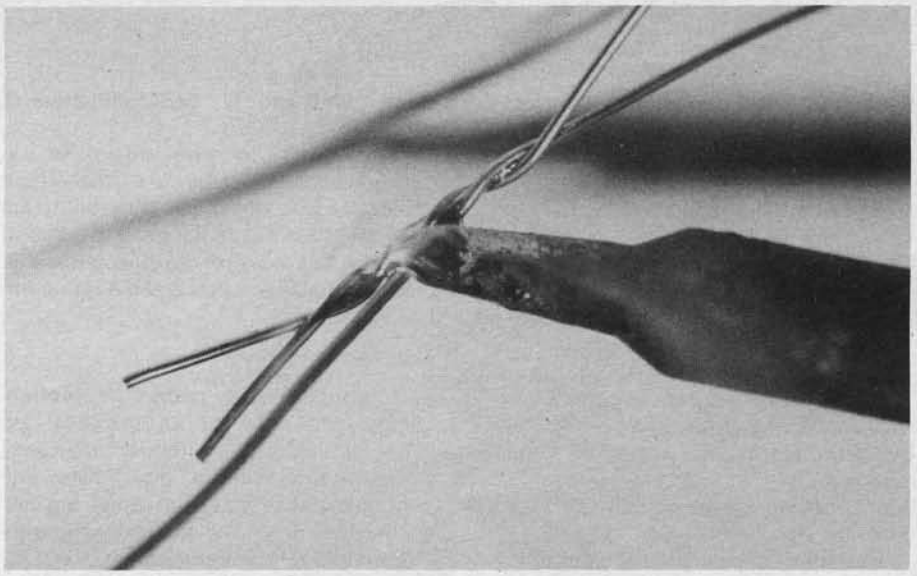
Back to the other tools. Obtain a good small pair of side cutters. Use these for cutting off the surplus wire from the joints soldering to the circuit board; but make sure that you don't cut too close otherwise you may disturb the joints.

So we have screwdrivers, spanners, soldering iron, solder and cutters. There

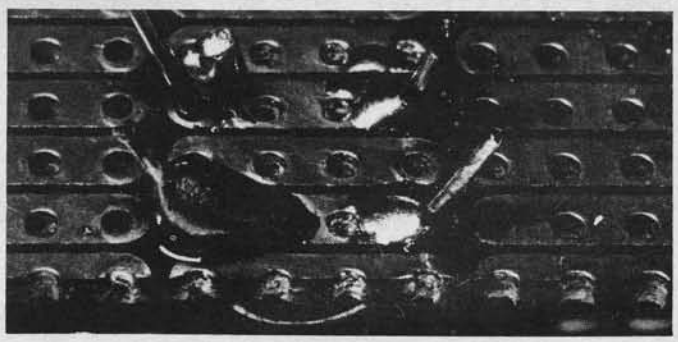


Top — **Only the centre joint is correct.**

Below — **A joint in progress.**



Above — **Soldering iron and stand.**

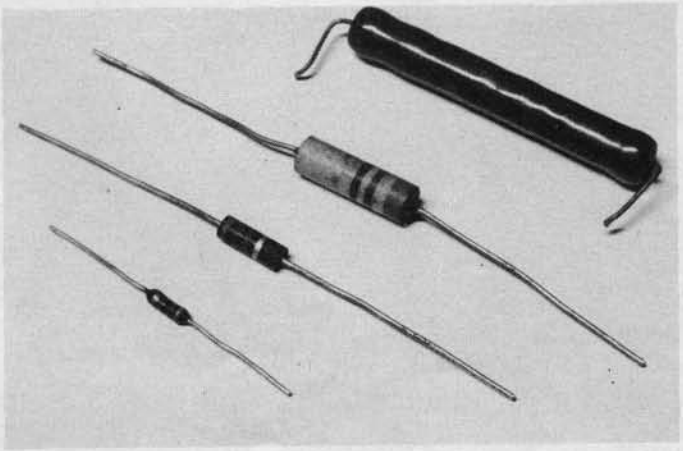


Right — **Veroboard joints, those on the left are incorrect.**

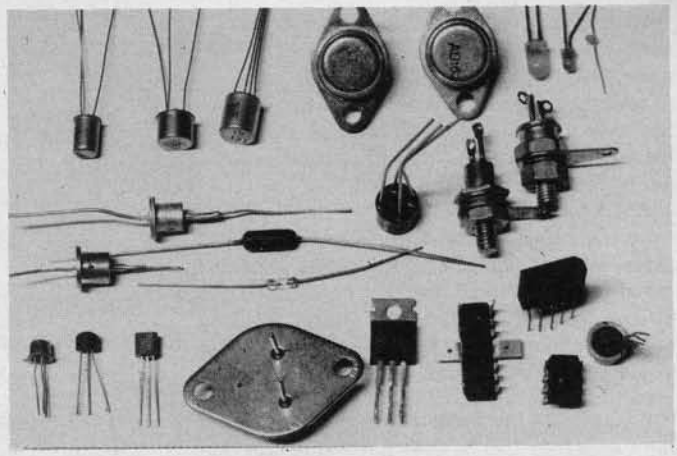
are of course many other tools which are desirable but not essential to make a start. The others will be detailed as we progress.

Components

Well up to now all we have made is a circuit board with a few wire loops so we ought to look at some of the actual components.



Resistors: $\frac{1}{8}$ Watt, see photo for correct value Watt, 1 Watt and 5 Watt.

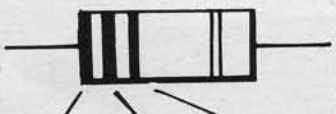


Semiconductors: Germanium, Diode, Silicon.

We can divide our components into 'passive' and 'active' types. Firstly 'passive' components are resistors, capacitors and inductors, whilst an 'active' component can be loosely described as one which provides amplification to a circuit such as a valve, transistor or integrated circuit. We usually require a combination of both types to achieve the desired operation of a circuit, be it a power supply, amplifier, burglar alarm or whatever. Each component has some form of identification so that we may tell what in fact it is.

Resistors for example are used to limit the current flow and have values measured in ohms either marked in figures or by colour code. This code, shown in the table, should be memorised. A capacitor value may also be shown colour coded; but it is more usual to mark the value and its working voltage somewhere on the body of the components. A capacitor can store electrical energy in the form of a charge. The amount will depend on the value. The greater the value, the greater the amount of energy stored. A capacitor will not allow (after the initial charge current) direct current (DC) to flow, but will pass on alternating current (AC) in the form of a charge/discharge/charge, also the effect of a coil of wire will appear different to an alternating current as opposed to a direct current. The basic unit of measurement is the Farad for a capacitor and the Henry for an inductance.

RESISTOR COLOUR CODE



Colour	*1st dig.*	*2nd dig.*	*Multiplier*
Black	0	0	1
Brown	1	1	10
Red	2	2	100
Orange	3	3	1,000
Yellow	4	4	10,000
Green	5	5	100,000
Blue	6	6	1,000,000
Violet	7	7	10,000,000
Grey	8	8	100,000,000
White	9	9	1,000,000,000
Gold	–	–	·1
Silver	–	–	·01

The tolerance band, right, is: Gold, 5%; Silver, 10%; None, 20%.

Transistors

I suppose the really interesting components used in an electrical or electronic circuit are the active ones, valves and transistors, etc. Valves are only used these days for rather special applications so we will not be dealing with them in this series of articles.

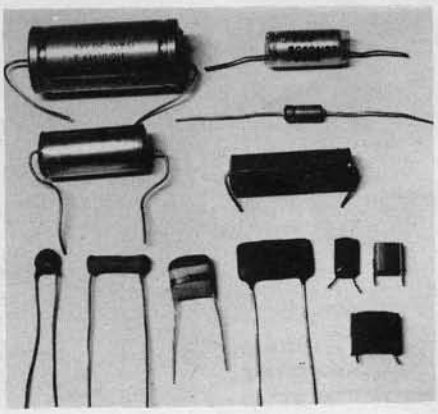
A transistor is a three terminal device, collector, emitter and base, made from a slice of silicon or germanium which has been 'doped' in one of many ways with a small impurity which will impart a characteristic flow of current between two of the terminals, emitter and collector, the third terminal, base, can by suitable connection, be made to influence that current flow. The main current flow can be made much greater than that which is controlling it and so we will have a useful measure of current amplification.

Dependent on the type of impurity used in the manufacture of each transistor will be determined by the 'polarity' of the device. Transistors can thus be made to operate in a circuit with a positive supply or with a negative supply, also by the basic design of the transistor they will have different parameters which will determine the code numbers allocated to the device, these are listed in the very many books published for reference. A very useful book for your workshop is 'Towers International Transistor Selector' by T. D. Towers which lists over 10,000 types including available substitutes. Familiarise yourself with the typical outlines of these devices and for simple circuits many types will be found to be interchangeable provided the basic parameters are adhered to, such as polarity, NPN or PNP (negative or positive), the working voltage as specified, etc.

If a circuit calls for a 24v collector to emitter device, obviously one which the table lists as only having a 10v specification will be unsuitable yet a 50v device will be OK. Power handling is also specified by type number as is the ability to work at high frequencies such as the early stages in radio sets, so any alternative must have similar characteristics.

I have just mentioned that the transistor may be chosen to work from a positive or negative supply. Where do we obtain this supply you may ask. Well one obvious answer is a small battery but a nice starting project would perhaps be a mains operated power supply.

Various types of capacitor.



A Power Converter

This could be made to give say 8 volts DC output at a fairly low current say 0.2 amperes. Such a power unit can be used to power many new projects and also be used to work a small cassette recorder or radio set normally running off 7.5 or 9 volts.

We have then 240v AC from the mains and we require to apply the information gained so far plus some more specifically applicable to this power supply and to finish up with 8 volts DC at the end of the exercise.

Firstly we must reduce the 240 volts to a much lower and safer voltage. We will use a transformer with an iron core. On this iron core will be two coil windings. One winding, consisting of a large number of turns, will be connected to the 240v supply and will produce a magnetic field in the iron core. The other winding which will have a lower number of turns will provide the lower voltage we require from the magnetic field produced by the first winding.

The voltage ratio will be the same as the turns ratio $\frac{V1}{V2} = \frac{N1}{N2}$. A small factor (efficiency) will in fact have to be introduced as no device is perfect.

However, we are not going to make the transformer, only use one purchased for the job.

Right, we now have a low AC voltage which we need to turn into direct current. The AC voltage as its name implies alternates from 0 to a positive value, then back to zero, from zero to a negative value and again back to zero.

We now use two diodes — devices which will only pass current in one direction, to change this alternating voltage into a pulsating direct voltage. This pulsating direct voltage rises from zero to a positive value, back to zero and back to the positive value, etc. If we used a pulsating voltage to power our equipment then a hum would result. We must have a steady supply like the battery we might be replacing. We achieve this steadier supply by fitting a capacitor across the DC output. This will accept a charge, as mentioned earlier, the first time the voltage rises from zero to a positive value. This charge will remain in the capacitor as the voltage returns to zero so filling in the ripples in the DC and steadying the supply.

In the design shown I have added a small integrated circuit. Although I have mentioned integrated circuits briefly I have given you no idea what they are. Due to the very concept of the IC there is no limit to the type of function that these units can be designed to perform, tens of thousands of types are available at present; but each one is built in micro miniature form by the manufacturer using the basic silicon slice that formed our transistor. On each slice of silicon many, many transistors are formed and interconnected to do the job required.

I have chosen a simple (from outside) IC, it only has three terminals and looks just like a small power transistor, but with characteristics very suitable for our power supply. If we had a small meter to check our power supply (more about meters in a later issue) we would find that the output would probably read 14 volts when not connected to a 'load', that is 'open circuit'. If we connected, say a cassette recorder we would find this voltage would fall to perhaps 9 or 10 volts. In other words we have built an unstabilised power supply. One which has a constant output from zero to full load is called stabilized and we use the integrated circuit to achieve this end. Built into the design by the manufacturers is an 8 volt reference so that whatever voltage the input rises to (within the limits specified for the IC) the output will remain at 8 volts. An added bonus is provided in this IC design. The output will fall sharply to zero if the current taken exceeds 200mA (0.2 ampere on design figure) and therefore our power unit is protected against accidental short circuits.

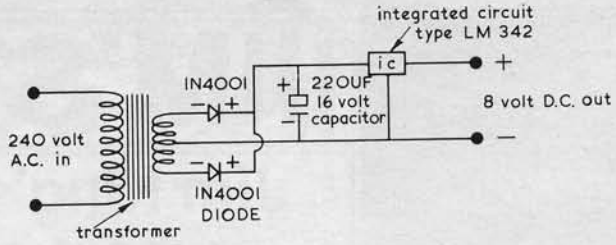
When building this simple power unit remember the rules for soldering, ensure the diodes, integrated circuit and capacitor are all fitted the right way round.

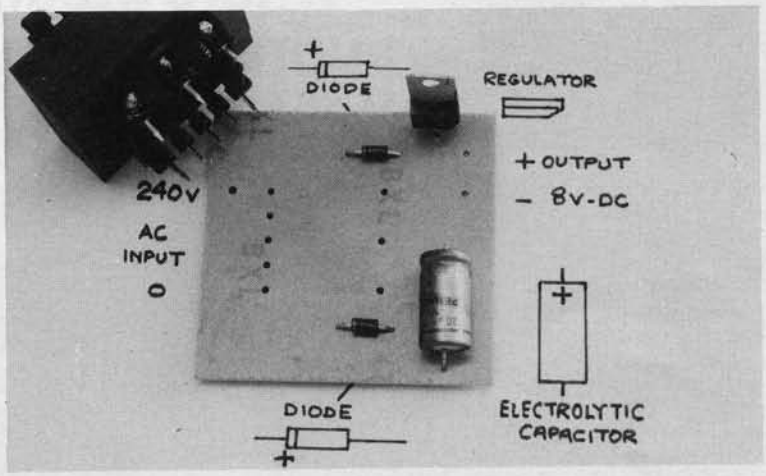
Remember that the input is 240v AC mains so treat it with respect, always treat mains electricity with respect.

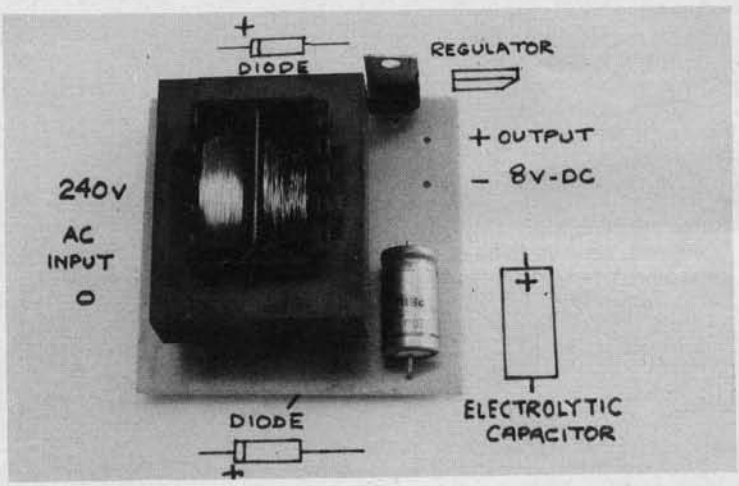
Finally make sure that any circuit or equipment connected to the power supply has any batteries removed and is connected the right way: positive to positive, negative to negative.

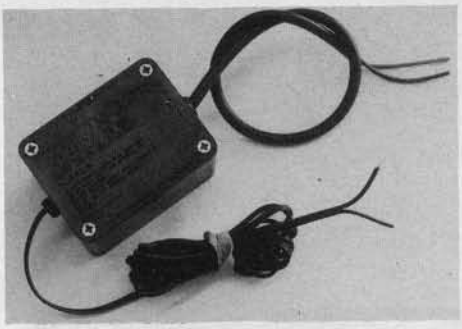
To be continued.

NOTE: **The power unit kit of parts is available from AGW Electronics Ltd. See advertisement.**









Various stages in manufacture —
Top: **Circuit.**
Second: **Printed circuit board with components positioned.**
Third: **Complete but for mains input lead and low voltage output lead.**
Left: **Complete in case.**